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ABSTRACT

This document is designed to provide educators with an objective synthesis of the current research on language development in children who are deaf. The materials reviewed were primarily peer-reviewed articles published in the last 10 years. Only references that focus primarily on deafness were included; however, some studies also involved children who are considered to be hard of hearing. Findings from the review indicate: (1) language development depends on frequent, consistent, and accessible communication, regardless of whether it is through signed or spoken language; (2) most children who are deaf not only start learning language later than their peers, but are confronted with less consistent language models when they do start; (3) children who are deaf who learn sign language as preschoolers show better academic achievement and social adjustment during the school years; (4) programs that combine sign language and spoken English may be more effective than programs that use either spoken or sign language alone; (5) cochlear implants improve speech perception, vocabulary growth, and receptive and expressive communication skills; and (6) administrators and policymakers can have a more positive impact on the language development of children with deafness by supporting early intervention. (Contains approximately 180 references.) (CR)

ED 455 620

# Language Development in Children Who are Deaf: A Research Synthesis

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June 2001

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*Prepared for:*
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# Language Development in Children Who Are Deaf: A Research Synthesis

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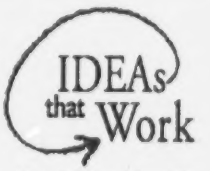


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# Language Development in Children Who Are Deaf: A Research Synthesis

## Executive Summary

This document is designed to provide educators with an objective synthesis of the current research regarding language development in children who are deaf. Unfortunately, many of the research findings are contradictory or inconclusive, and numerous questions remain unanswered. What is clear from the research is that intervention plans and educational programming decisions should be made based on the needs, capabilities, and circumstances of the individual child. The child who has hearing aids, the child who has a cochlear implant and uses oral-auditory strategies, and the child with a cochlear implant for whom using sign language in addition to oral-auditory training has been recommended, and the child who uses sign only, will all need different support strategies.

The research also points to the importance of beginning an intervention strategy and support services at the earliest possible time, regardless of the degree of hearing loss or mode of communication. With more than 30 states mandating universal newborn hearing screening and more coming on line, children are being identified at much earlier ages and the variety of interventions will bring a more diverse population of children who are deaf into the educational system.

The decision to focus on deafness for this research synthesis is an acknowledgement that the needs of children who are hard of hearing are very often different than the needs of children who are deaf. And there will, of course, be many children with mild to moderate hearing losses or late-onset hereditary losses who will need special attention by educators.

### *Practical Challenges*

Several practical challenges to conducting research on language development in deaf children complicate research in this field. For instance, it is difficult to make comparisons across children because sign language is typically the main mode of communication for deaf children of deaf parents; whereas spoken language is more likely to be the primary mode for deaf children of hearing parents. This means that children who are deaf do not all have access to the same types of language experiences. Further, children who are deaf are a heterogeneous group in terms of degree of hearing loss and age at which hearing loss occurred. It is also difficult to make comparisons between educational programs emphasizing spoken language and those emphasizing sign language. Programs often have different educational curricula, or favor the admission of children with particular histories of intervention, which means that differences observed between children from any two programs might be the result of any of a number of variables rather than the type of educational program.

***Language Development***

Studies with children and their mothers show that language development depends on frequent, consistent, and accessible communication, regardless of whether it is through signed or spoken language. These early interactions establish the foundation upon which language develops. Deaf children who are born to deaf parents are usually exposed to sign language from an early age, providing a common language through which parents and children can easily communicate. The majority of deaf children, however, are born to hearing parents who are unlikely to be fluent users of sign language. Because these children do not share a common language with their parents, they tend to be exposed to less linguistically rich environments than either hearing children of hearing parents, or deaf children of deaf parents. It is important to note, however, that the overall language advantages seen in deaf children of deaf parents seem largely attributable to the language learning *environment* rather than anything inherent in sign language per se.

Significantly, most deaf children not only start learning language later than their peers who share a common language with their parents, but are confronted with less consistent language models when they do start. In spite of these challenges, the development of both signed and spoken language follows the same course in deaf as in hearing children, even if a lack of early language experience creates a lag in development for some children who are deaf.

Recent educational and policy changes have affected the way in which children who are deaf are raised and educated. It is now clear that enrollment in an early intervention program is one of the single best predictors of positive developmental and educational outcomes for children who are deaf. At the time of printing, 32 states and the District of Columbia had Early Hearing Detection and Intervention legislation, and first-time legislation was proposed in three more states. Research suggests that a combination of both early detection and early intervention is particularly effective in facilitating language development.

***The Relationship Between Signed and Spoken Language***

For years, educators questioned whether teaching young deaf children sign language would impair their ability or motivation to learn spoken English. There is no evidence that the early use of signs by deaf children hampers their development of spoken English. Nor is there evidence that early introduction to spoken English negatively affects later acquisition of signing. Sign language may even provide a bridge to spoken English. Further, research indicates that deaf children who learn sign language as preschoolers show better academic achievement and social adjustment during the school years.

Most investigations of language development in children who are deaf have examined the development of either signed language or spoken language but not their possible interaction. Preliminary findings suggest that programs that combine sign language and spoken English (also known as bilingual education programs) may prove more effective than programs that use either spoken or sign language alone. In other words, sign language and spoken language should not be considered as mutually exclusive alternatives, but as potentially complementary strategies for

encouraging language development in deaf children. Some deaf individuals will prove to be more comfortable with spoken language than others, and some will be more competently bilingual. Deaf children's relative fluencies in the two modalities will depend in part on age of onset and the degree of hearing loss. Other factors such as parental language input, quality of early education, and exposure to spoken and signed language may also make a difference.

***Cochlear Implants***

One group of children for whom the combination of spoken and sign language may be especially significant is young deaf children who have received cochlear implants. Signing may be an important accompaniment to spoken language, as many deaf children with cochlear implants function more like hard-of-hearing children than hearing children. Research findings clearly indicate that cochlear implants improve speech perception and that some children benefit more from implants than they would be expected to from hearing aids. Findings also suggest that vocabulary growth and receptive and expressive communication skills are enhanced by cochlear implants, at least for children who have had some exposure to auditory input prior to hearing loss, and early cochlear implantation does not appear to impede sign language acquisition. At present, there is relatively little information available to indicate in advance, who will benefit from implants and who will not because implant candidates usually are chosen for their apparent aptitude for spoken language. Carefully designed longitudinal research continues to be needed that examines such factors as length of auditory experience prior to implantation. Also, more research is needed with children of differing ages at implantation, differing communication exposures (i.e., sign, spoken, or a combination), and differing intervention strategies. This is especially important as the number of children who receive implants and enter their neighborhood schools grows.

***Language Development and Academic Implications***

In addition to developing the basics of language, it is important to consider the links between language development, literacy, and academic success. Because the majority of deaf children are born to hearing parents who do not know how to sign, many of these children do not have full access to language during the early years of life most critical to language acquisition. Research indicates that for most children who are deaf, exposure to spoken language only does not provide them with the linguistic tools necessary for academic and social success. For example, deaf children of hearing parents have fewer signed or spoken labels for things around them than hearing children of hearing parents, or deaf children of deaf parents. Compared to normally hearing children, deaf children also are more likely to use concrete nouns and familiar action verbs than abstract or general words with which they may have less experience.

Special efforts, therefore, need to be made to expand the vocabularies of deaf children through print, sign and speech. The educational system has so far been unsuccessful in supporting the majority of deaf students to develop reading skills commensurate with those of their hearing peers. Studies have shown that having parents who can sign well, whether deaf or hearing, and who read regularly with their deaf children – ensuring comprehension via use of sign language – are extremely important factors in children's development of literacy skills. Additionally, regardless of parents' hearing

status, deaf children who are better readers had their hearing losses diagnosed earlier, had early access to language (usually via sign language), and were exposed to English.

***Interpreting & Technology in the Classroom***

It is widely assumed that the accessing of print through closed captioning and speech-to-print software will facilitate the acquisition of English literacy skills by deaf children. Numerous questions remain, however, as to the effectiveness of these technologies. For instance, captioning speed often exceeds the rate at which most deaf students are able to read, and much captioning contains spelling and grammatical errors. Only when sufficient research has been done on the effects of these technologies will it be possible to determine their effects on language and literacy development, and to determine how best to use them to the educational advantage of deaf children.

***Bilingual Education and Literacy***

Recent evidence suggests that a combination of both American Sign Language (ASL) and English-based signing may be a powerful combination in the academic success of children who are deaf. Research concerning the link between early exposure to ASL and English literacy scores, however, is still mixed. ASL provides access to early communication between parents and children, which in turn can promote the language and cognitive skills necessary for literacy and academic success in other areas. But ASL, not having a written form, cannot provide a bridge to written English on its own. English-based signing may be an effective way to introduce deaf children to English grammar and syntax, if it is accurate and complete.

Total Communication programs (utilizing simultaneous spoken and signed language) have not successfully improved literacy; consequently, there is a growing trend toward bilingual education for deaf children (alternating spoken/written English and ASL). Although ASL is typically promoted as the first language for children in these programs, the goal is to ultimately produce students who are proficient both in ASL as well as in written and, perhaps, spoken English. In part because of the considerable diversity among bilingual programs, their impact has not yet been fully evaluated. Nevertheless, there is consensus that these programs hold promise, and a recent survey of teachers and researchers indicated that evaluating these programs is at the top of their research agenda.

***Guidelines for Practice***

Although many questions remain unanswered, current research can be used to guide parenting and educational practice for children who are deaf. In terms of early intervention, it is essential that parents be taught to use visual strategies for enhancing communication with their children who are deaf, regardless of whether they use spoken or sign language. Parents also need to be advised about the importance of reading with their young children, and instructed on methods by which they can combine sign language with spoken language. During the early years of language development, visual aids should be used in establishing links between words and word categories (e.g., bread is a type of food, made from grain, etc.).

Within the classroom, reading and writing activities should be given high priority. Having students retell stories at home, collect or draw relevant pictures, and act out portions of stories can help establish links between written words and their meanings. In order to foster both language development and literacy skills, attention should be given to categories, relations among concepts, and multiple meanings of words. Academic outcomes for deaf children appear to be improved by the use of more visually-oriented teaching strategies, early introduction of sign language to enhance language and cognitive development, classroom activities that emphasize relations among concepts, and more spoken language in early education settings. Finally, as the number of children receiving cochlear implants continues to grow, there will be an increasing need for appropriate in-class support for these children who tend to function like children who are hard of hearing.

***Guidelines for Policy***

Research indicates that administrators and policymakers can have a more positive impact on the language development of children who are deaf by supporting early intervention for families, and establishing parent training workshops. Furthermore, evidence that deaf children benefit from early exposure to sign language points to the need for in-depth sign language training for parents and other caregivers, with special attention to underserved populations such as those in rural areas. In addition, adults supporting deaf children in the classroom need to be able to demonstrate fluency in sign language.

Teachers and researchers agree on the urgent need to implement evaluation procedures for early intervention and bilingual education programs already in place. Faced with demands for newer and more sophisticated instructional technology at increasing costs, educational administrators join teachers and researchers in advocating for more research demonstrating the impact of new technologies. Greater research consideration must be given to which technologies offer long and short-term benefits in which domains.

Research also supports the fact that families should be involved in making decisions about educational programming for their children, in conjunction with educational professionals. A broad range of services is necessary to be able to provide optimal support for the heterogeneous needs of children who are deaf. Because neither spoken nor sign language is inherently superior, it is important that we always consider the unique circumstances and needs of each child and family in determining the best program for him or her. Decisions must be made with full access to pertinent research-based information, which points to the need for more education for parents, teachers, and other adults who spend a significant portion of time with children who are deaf.

# Language Development in Children Who Are Deaf: A Research Synthesis

## Introduction

Great strides have been made over the last 20 years in research concerning language development and the education of children who are deaf. However, conflicting results reported in the literature, gaps in the research, and sincere differences of opinion make it difficult to answer two seemingly simple and straightforward questions regarding any given child who is deaf: *What is best — speech, sign or both? What strategies are best in various settings?* School officials, teachers, researchers, and policymakers thus may have different responses to the same questions — responses that will be affected by their own perspectives and backgrounds, and the characteristics and environment of the particular child.

This document is designed to provide educators with an objective synthesis of the current research regarding language development in children who are deaf. Unfortunately, many of the research findings are contradictory or inconclusive, a standard problem with an evolving area of research with small numbers of subjects in a variety of settings. Numerous questions remain unanswered. What is clear from the research is that intervention plans and educational programming decisions should be made based on the needs, capabilities, and circumstances of the individual child. The child who has hearing aids, the child who has a cochlear implant and uses oral-auditory strategies, and the child with a cochlear implant for whom using sign language in addition to oral-auditory training has been recommended, and the child who uses sign only, will all need different support strategies. With this in mind, it should be recognized that current research cannot provide complete guidance for policy and practice in regard to educating children who are deaf, and certainly cannot provide specific guidance for a particular child, as individual circumstances greatly influence outcomes.

The research does, however, point to the importance of beginning an intervention strategy and support services at the earliest possible time, regardless of the degree of hearing loss or mode of communication. With more than 30 states mandating universal newborn hearing screening and more coming on line, children are being identified at much earlier ages and the variety of interventions will bring a more diverse population of children who are deaf into the educational system.

The materials reviewed for this document were primarily peer-reviewed articles published in the last 10 years. Additional materials were used to illuminate a topic or address a particular issue. Only references that focus primarily on deafness were included; however, some studies also involved children who are considered to be hard of hearing. This is not to imply that a parallel literature exists that focuses exclusively on children who are hard of hearing. This is not the case because hearing losses inherently fall along a continuum, and it is not always possible to make a clear distinction between individuals who are deaf and those who are hard of hearing. In the present document, "children who are deaf" generally refers to those with hearing losses considered "severe" to "profound" (i.e., at least 71dB loss in the better ear, without amplification). Across the research reviewed, "deaf" will have slightly different meanings, depending on the characteristics of the

samples involved. Within the range of hearing loss considered here, however, there is no evidence that the differences have any significant implications for interpretation of the results (e.g., degree of hearing loss does not predict the development of speech or language skills [Yoshinaga-Itano, 2000]). Definitions of other terms used in this document can be found in the glossary located before the reference section.

The decision to focus on deafness for this research synthesis is an acknowledgement that the needs of children who are hard of hearing are very often different than the needs of children who are deaf. There will, of course, be many children with mild to moderate hearing losses or late-onset hereditary losses who will need special attention by educators. The reader is encouraged to begin the search for information on children who are hard of hearing by visiting the websites listed at the end of this document.

***Practical and Theoretical Challenges***

In attempting to provide an integration of the empirical evidence relevant to language development among children who are deaf, we have to recognize that what might seem to be dichotomies in language development often represent two ends of a continuum. Three such dimensions are noteworthy here. First, the separation between "spoken language" and "sign language," while a theoretically important one for linguists and other investigators, is clearly an oversimplification. It is rare that deaf children are exposed only to spoken language or only to sign language, even if that is the intention of their parents or their teachers. The realities of the world are such that even while spoken language predominates in the environment, most deaf children are still exposed to some form of sign communication, either formally or informally. Therefore, it is usually more useful to focus on which language modality is *primary* for a particular child (Calderon & Greenberg, 1997; Mayberry & Eichen, 1991). But even the designation of primary mode of communication is not entirely clear. For educational purposes, "primary" refers to the means of communication a child uses most fluently and frequently in communicating wants, needs, and ideas, and the means of communication the child understands best (receptive language). This is sometimes distinct from the mode of expressive or receptive communication that parents or school staff/teachers would prefer for the child.[1]

Typically, sign language will be the primary mode for deaf children who have deaf parents, whereas spoken language is more likely to be the primary mode for deaf children of hearing parents—independent of each child's degree of hearing loss. Particular deaf parents and deaf children with some residual hearing also benefit from spoken language while still using sign language in some contexts. Similarly, even when deaf children are educated in spoken language environments, systems of gestural communication may develop between parents and children (e.g., Greenberg, Calderon, & Kusché, 1984). Such variability will play an important role in the language models available to children who are deaf. For clarity and to parallel terminology within the existing literature, discussions below focus on one language modality or the other. The mixing of spoken and signed languages will also be considered in assessing the influence of early sign language on the development of spoken and written English skills and the implications of bilingual educational settings.

Often referred to as another dichotomy, gesture and language are better viewed as representing two positions on a *communicative continuum* (e.g., Bates, Thal, Whitesell, Fenson, & Oakes, 1989; Kendon, 1988; McNeill, 1992; Stokoe & Marschark, 1999; cf. Singleton, Goldin-Meadow, & McNeill, 1995). Although discussions of gesture have a prominent role in research on early language development, the topic is almost entirely omitted from literature concerning school-aged children, in favor of a focus on words, sentences, discourse, and so on. Several studies, however, have demonstrated that deaf adults and children frequently use gesture intermixed with their sign language as a highly flexible descriptive tool (e.g., Everhart & Marschark, 1988; Marschark, Everhart, & Dempsey, 1991). Psychologically, the important thing is that deaf children's gestures elicit language and social responses from others in the environment, an issue considered in more detail later.

Implicit throughout this document is a third apparent dichotomy, that between "deaf" and "hearing." This distinction may seem clear in the case of children with normal hearing and those with profound hearing losses. Even there, however, hearing aids, a cochlear implant, or residual hearing may provide auditory information to a profoundly deaf child in support of language development, even if they do not provide for the full perception of spoken language. These auditory signals may indicate that a language event is happening, call attention to possible relations between events and related language or communicate social information such as turn-taking demands and parental emotional responses. In short, it is helpful to keep in mind that the acquisition of sign language by most "deaf" children is supported by spoken language and exploitation of sound in the environment. Auditory input to a deaf child may be "language" to the speaker, but it might not function as useful linguistic input to the child, even though it provides cues to the ebb and flow of events in the environment.

Dichotomies aside, language development in children who are deaf is also affected by an interaction between degree of hearing loss and the communication fluency of language models. Many hearing parents who choose to raise their young deaf children using sign communication, for example, do not sign with any consistency, a situation also encountered when various forms of English-based signing or cued speech are used. Parents typically have had little formal training in these methods and may be uncomfortable using them in public. Further, hearing parents may only sign when speaking directly to the child, even though much of language is learned indirectly from overhearing conversations of others, from television exposure, and similar sources. At the same time, children with greater hearing loss do not have access to the spoken language of their parents, even if they indicate their awareness of the fact that someone is speaking. Young deaf children of hearing parents thus frequently do not have any truly accessible and competent language models, either for sign language or for spoken language. To the extent that language acquisition is positively related to the diversity of adult language models available (Nelson, 1973) and social reinforcement from those models (Whitehurst & Valdez-Menchaca, 1988), deaf children clearly will be at significant disadvantage for language development.

Problems of interpretation also arise in attempts to compare the language abilities of deaf children who are raised using primarily sign language and deaf children who are raised using mainly spoken language. Such comparisons represent one of the most popular and potentially informative areas in

research relating to language development among children with hearing loss, but they are also one of the most intractable. Educational programs emphasizing spoken or sign language often have different educational philosophies and curricula as well as different communication philosophies. Programs may favor the admission of children with particular histories of early intervention, and different parents will be drawn to different programs for a variety of reasons. Differences observed between children from any two programs, therefore, might be the result of any of a number of variables rather than, or in addition to, language orientation *per se*. The relation between language development and school program is thus another seemingly simple question that is exceedingly difficult to answer. In short, there are a variety of obstacles to conducting and interpreting research on language development in deaf children, due to both *nature* and *nurture* factors. The challenge is to discover the particular mix of experiences that have significant, long-term impact on language development and, in a research context, to control or minimize those experiences that are extraneous (Nelson, Loncke, & Camarata, 1993).

## A Context for Exploring Language Development in Children Who Are Deaf

Studies of spoken language development in children with congenital or early-onset hearing losses generally reveal them to have significant delays relative to hearing age-mates. Importantly, this finding does not occur only in cases of permanent, severe hearing losses; such delays also are observed when children have losses in the mild to moderate range (Carney & Moeller, 1998; Gregory & Hindley, 1996). It takes very little distortion in hearing to create difficulties for language development, and recent research has even indicated that chronic otitis media (middle ear infection) can lead to delays in reading ability and lower performance on verbal intelligence tests (Johnson, Swank, Owen, Baldwin, Howie, & McCormick, 2000; Kindig & Richards, 2000). Findings from studies described in this synthesis concerning language development in children who received cochlear implants also suggest that those children who had several months of hearing prior to the onset of deafness had more advanced language development after implantation, and implants may have been a benefit in educational and social contexts. The relative inaccessibility of spoken language for most deaf children and the difficulty of learning to read speech information on the lips without prior language experience thus clearly has important consequences for language development (COED, 1988).

Given the apparent importance of early auditory stimulation for social and cognitive development as well as language development (e.g., Quittner, Smith, Osberger, Mitchell, & Katz, 1994; Spencer, 2000), lags in language growth among many children with hearing loss are not surprising. Most investigations of language development in children who are deaf, however, have examined the development of *either* signed language or spoken language, and not their possible interaction. This situation is all the more striking given that the Commission on Education of the Deaf (COED) noted that the age at which hearing loss occurs influences the language a person will use throughout life:

> Persons who become deaf after learning spoken language (postlingually) can continue to use those skills in later educational and social contexts. However, this is true for only about 5 percent of children who are deaf . . . Although lip reading provides some language-learning cues to the child, at most only 40 percent of the sounds produced in

> the English language is visible on the lips. While intensive auditory intervention may greatly enhance the speech reception of some, other young deaf children may understand as little as 5 percent of what is said to them. The process of acquiring a spoken language is very difficult for a child who does not have access to the full range of auditory stimuli. (COED, 1988, p. 15)

Sign language can serve as an effective mode of communication for young deaf children, revealing all of the stages typical of spoken language acquisition when acquired naturally as a first language. What is not clear is the extent to which sign language learned from less-than-fluent models is comparable to spoken language for the purposes of development and education. In particular, many parents and educators are concerned about the effectiveness of signed language in providing a bridge to reading and writing. An empirical question remains: Are signed and spoken languages equivalent in academic settings? In providing an overview of research concerning language development in children who are deaf, this document also will discuss some broad principles of language acquisition, particularly with regard to their larger role in children's development and education.

### *A Changing Landscape*

Understanding language development in children who are deaf is made more difficult by the fact that as a group, they have considerably more variety in their language experiences than normally hearing children. Children who are deaf are affected by most of the same factors influencing the development of hearing children, including early childhood diseases, diversity in their social environments, the socioeconomic status of their parents, and so on. In addition, those children face a variety of challenges associated with or created by their hearing loss, and thus not encountered by most hearing children, such as associated medical conditions, parents' difficulties in accepting disability, barriers to access in the family and at school, and perceived social stigma. Recent educational, scientific, and legal changes have also affected the ways in which children who are deaf are raised and educated in many countries. These changes have added to the difficulty of finding answers to some key research questions and have created more ambiguity with regard to several practical issues.

Research during the 1980s, for example, demonstrated that deaf children of deaf parents who were exposed to sign language as their first language, acquired that language at much the same rate and with the same milestones as hearing children acquired spoken language (see Newport & Meier, 1985; Siple, 1997, for reviews). Such results supported the linguistic and psychological equivalence of signed and spoken languages while contributing significantly to our understanding of the nature of language and language development. Perhaps most importantly, these findings indicated that deafness *per se* could not explain the developmental and educational challenges observed among deaf children from hearing families. Other factors had to be involved, and a significant body of research emerged concerning differences between deaf children from deaf families and those from hearing families, as well as comparisons of both groups to hearing children from hearing families.

Another relatively recent development is the broad establishment of early intervention programs for young deaf children and their families. These programs vary in their communication orientations and the range of services they offer, but it is now clear that enrollment in an early intervention

program is one of the single best predictors of positive developmental and educational outcomes for children who are deaf (Calderon & Greenberg, 1997; Carney & Moeller, 1998). All other factors aside, there is no doubt that such programs have been a major factor in improving the overall language abilities of deaf children over the last two decades.

Another change affecting the education of children who are deaf is derived largely from the Education for All Handicapped Children Act (Pub. L. 94-142) in 1975, now known as the Individuals with Disabilities Education Act (IDEA). IDEA promotes the greater involvement of families in educational decision-making for their children, through the establishment of Individualized Education Programs (IEPs). Recognizing the importance of accessible language to the educational success of deaf children, the IDEA Amendments of 1997 (Pub. L. 105-17) further specified that in the development of IEPs, the IEP team should

> ...consider the communication needs of the child, and in the case of a child who is deaf or hard of hearing, consider the child's language and communication needs, opportunities for direct communications with peers and professional personnel in the child's language and communication mode, academic level, and full range of needs, including opportunities for direct instruction in the child's language and communication mode;...
> [20 U.S.C. §1414(d)(3)((B)(iv)]

The opportunity for broader family participation in educational planning and explicit consideration of family, social language and academic language needs, as well as the move toward educating deaf children in local public schools have affected several factors known to be related to language development. Among these are the child's exposure to adult language models, interactions with multiple deaf and hearing peers, issues of self-esteem, perceived ability to control events (locus of control), the level of parental expectation, and the level of teacher expectation for the deaf child.

Recent advances in medicine and technology also are significantly changing the education of children who are deaf. Most obvious with regard to medicine is the elimination of some formerly common etiologies of hearing loss in children (e.g., maternal rubella) and the relatively greater prevalence of others (e.g., more babies surviving premature birth). Of growing significance, however, is the rapidly increasing number of deaf children who are receiving cochlear implants. Research concerning effects of implants on aspects of development other than auditory perception is accelerating and includes continuing investigation into language development and optimum conditions for candidacy.

Finally, it is noteworthy that the Newborn Infant Hearing Screening and Intervention Act of 1999, as introduced by Representative James Walsh (R-NY), was incorporated under Title VI, Section 601 of the Labor, Health and Human Services, Education, and Related Agencies Appropriations Act for Fiscal Year 2000, H.R. 3424. The appropriations bill was rolled into an omnibus appropriations measure which was signed into law (Pub. L. 106-113) by President Clinton on November 29, 1999. That law authorized federal agencies, including the Health Resource and Services Administration, the Department of Health and Human Services, and the National Institute on Deafness and Other Communication Disorders (NIDCD) to aid in the development of newborn and infant hearing

screening programs. The three agencies are to work together to develop programs that: (1) support statewide newborn and infant hearing screening, evaluation, and intervention programs and services; (2) provide technical assistance for data management and applied research; and (3) enhance research on the efficacy of new screening techniques and technology for newborn infants.

At the time of this printing, 32 states and the District of Columbia have Early Hearing Detection and Intervention (EHDI) legislation, and first-time legislation is proposed in three more states. For current state-by-state information regarding the implementation of universal hearing screening, please refer to the following web site, maintained by the American Speech and Hearing Association (ASHA): http://www.asha.org/infant_hearing/index.htm.

Once universal hearing screening is fully implemented, hearing losses in young children will be identified much earlier than age 2 to 3 years that is now common, and appropriate measures can be taken to optimize their environments for language development and later educational success. Several recent studies have indicated that the combination of universal screening and very early intervention (preferably by about six months of age) can particularly facilitate language development (e.g., Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000; Mayne, Yoshinaga-Itano, & Sedey, 2000; Yoshinaga-Itano & Apuzzo, 1998). Yoshinaga-Itano and Apuzzo (1998), for example, found that children who began in an intervention program prior to six months of age showed significantly greater progress than children who started after six months of age.[2] In order to take full advantage of this opportunity, however, there is the need for more research specifically directed at several areas of language development in deaf children as well as expanded and improved parent and teacher education programs. There is also a need for research on the type of classroom accomodations that optimize the acquisition of language and learning in children who have mild to moderate or late-onset hearing losses.

***Issues and Orientation***

Any attempt to integrate the diverse body of research touched on in this document is sure to raise a number of social and cultural issues concerning the education of deaf children. With the changes described above and the recognition of deaf people as a linguistic and cultural minority group in this country, the long-running discussion about the "best" methods for optimizing language development of deaf children has changed significantly. Additional perspectives have blended into the discussion, and social constructions have been added to educational theory in explorations of what works for whom and when (see Gregory & Hindley, 1996).

In order to fully understand language development in this broader context, it is important to understand the complex relations between it and other domains of development. This requires a look at both *how* children go about acquiring language and exactly *what* it is that allows them to communicate with others. The goal here is to understand what children who are deaf need to know in order to be able to use language for face-to-face communication and, later, in reading and writing. In both of these domains, it will be important to distinguish differences due to the modality of communication from differences in communication skill or language ability. Throughout this document, therefore, "mode" and "modality" will be used to refer to the actual communication

behaviors used by children, rather than as a description of a particular educational method (Nicholas & Geers, 1997). The latter will be specified, as necessary.

It is important to maintain an objective stance throughout this discussion, recognizing the equipotentiality for spoken language and sign language in educating children with hearing loss. Issues concerning relations between the language used at school and the language used at home are considered later in several contexts. Most central are the ways in which exposing children primarily to a spoken or sign language, or attempting to expose them equally to both, might have significant implications for academic success in general and for their gaining English literacy in particular.[3]

## Availability of Language and Communication for Children Who Are Deaf

In the 1960s, about 90 percent of hearing parents in the United States used only spoken language with their deaf children, while the remainder used some form of "manual communication." The use of sign languages began to increase when they were recognized as being natural languages rather than ad hoc gestural systems (Stokoe, 1960), and by the 1980s, more than 66 percent of school programs for deaf students incorporated at least some signing in their curricula. According to the Gallaudet Research Institute's 1999 Annual Survey of Hearing-Impaired Children and Youth, approximately 56 percent of deaf *and hard of hearing* students in the United States are reportedly being educated in programs that use sign language either exclusively (5 percent) or in combination with spoken language (51 percent), and more than 80 percent of schoolchildren with severe to profound losses are now exposed PRIMARILY to sign language at school. But these numbers do not tell the whole story. For example, in the Ontario Deaf Study, involving 153 Canadian children who were deaf, Akamatsu, Musselman, and Zweibel (2000) found that 93 percent of children initially were enrolled in auditory/oral programs. By preschool, 67 percent were still being educated orally, a number that declined to 58 percent during elementary school and to 31 percent among adolescents. Fewer than half of the children who use sign language in school also sign when they are with their families, and only a small fraction of those children are able to carry on normal everyday conversations with their parents. Deaf children born to deaf parents who use sign language will be exposed to language from the beginning of their lives—a language that serves both social and educational functions. Meanwhile, the majority of children who are deaf "are relatively deprived of linguistic input and develop language in a less rich linguistic environment than hearing children or deaf children with deaf parents" (Lederberg & Spencer, 2001, p. 3).

### *Origins of Parent-Child Communication*

To understand fully language development in children who are deaf, it is important to put early interactions with their parents into the larger context of development. In particular, the competencies and strategies children learn with their parents have wide implications for language development and help to set the stage for exploration, learning, and further social interactions. It is important to note that most of the studies of parent-child communication have been done with mothers. More research is needed in the area of father-child interaction.

Even before birth, it appears that the sounds in a hearing child's environment can directly or indirectly affect several aspects of development. During the last trimester of pregnancy, hearing fetuses react to sound, and especially to human speech. For those mothers who speak and are carrying babies who can hear, this presents the opportunity for the fetus to hear its mother's voice and heartbeat through bone conduction. The mother's voice and heartbeat are familiar stimuli to newborns and have a quieting effect because of their familiarity. The ability to discriminate mother's voice from the voices of other women clearly has an important social-biological function. That the fetus experiences its mother's voice before birth is not a matter of dispute. How the effects of that experience are interpreted, however, has important implications for our understanding of children who are born deaf and also for those hearing infants who are born to deaf parents.

The results of available studies indicate that for hearing mother-infant dyads, prenatal and early post-natal maternal speech can play a role in initial mother-child bonding that, in turn, supports development in other domains. Deaf infants and their hearing mothers, on the other hand, may have different interaction strategies than infants and parents who share a common hearing status and language, differences that may have long-term consequences for language development. For example, we know that normally hearing babies are able to match different faces to their respective voices at as early as 2 months of age, and they can decipher the affective tone of maternal speech by 9 months. Those linkages are based largely on the extensive, post-birth interactions of mother and infant rather than on voices heard in the womb. The interesting question is whether the absence of vocal-auditory cues has any particular consequences for development or is compensated for by alternatives in other sense modalities. Earlier identification of significant hearing loss through newborn hearing screening is likely to have important consequences for mother-infant communication.

Both deaf and hearing mothers of deaf infants spend considerable time interacting with their newborns in a variety of modalities (Koester & Trimm, 1991; Rea, Bonvillian, & Richards, 1988; Spencer, 1993a, 1993b), and we know that infants are able to make use of a variety of available information sources to make sense of individuals and events in the world. Snitzer Reilly, McIntire, and Bellugi (1990) reported that facial expressions associated with the basic emotions are produced consistently by both deaf and hearing children by 12 months of age. At that age, deaf children of hearing parents also were seen to have command of basic affective displays and use a variety of nonvocal attention-getting devices Snitzer Reilly and Bellugi (1996) examined the American Sign Language (ASL) productions of deaf mothers signing to their deaf preschooler, and found that mothers were implicitly sensitive to the need for clarity of communication and were "willing" to produce ungrammatical language in order to achieve clarity. Taken together, these findings suggest that many of the earliest communicative interactions between mothers and their deaf infants proceed quite naturally, at least when the mothers are also deaf. Particular aspects of communication may be superficially different than they are for hearing mothers with hearing infants, but they serve the same communication and social functions.

In the case of hearing mothers, it is difficult to assess the full impact of the lack of vocal-auditory communication on early interactions with their deaf infants. The effects of this lack of communication would be less pronounced when parents are aware of their infant's hearing loss (e.g.,

when there is a history of deafness in the family) than when they are unaware of the hearing loss. With knowledge of the hearing loss, parents could engage in a variety of strategies that enhance interactions in non-auditory domains (e.g., Erting, Prezioso & Hynes, 1990; Koester, Brooks, & Traci, 2000). Although it is unclear to what extent such compensation is necessary, enhancing interactions in non-auditory domains likely contributes to the growth of parent-child relationships and fosters the development of effective language.

Consider, for example, early communication in the first year of life, when both deaf and hearing children are beginning to make regular vocal sounds and hand movements. Whether or not they are seen as true attempts to communicate, deaf and hearing parents frequently respond to infants' gestures and vocalizations, respectively, thus supporting the establishment of both social communication and various language functions. As discussed below, these early interactions establish the basis on which language development builds, making the accessibility of language essential in the first three years of life (Luetke-Stahlman, 1993).

***Sensitivity to and Strategies for Communication***

Beyond parental attitudes toward congenital and early childhood hearing loss, perhaps the single most important variable in development is the availability and accessibility of parent-child communication. Shared communication greatly enhances language development and permits relaxed and effective parent-child interactions (Harris & Mohay, 1997). An early foundation in language, in turn, supports the acquisition of literacy as well as cognitive and social skills during the school years, and may be the single best predictor of academic success (Drasgow, 1998; Risley & Hart, 1995). For the 90 percent of deaf children born to hearing parents, however, language acquisition remains a significant challenge and most often is found to be delayed relative to both hearing children of hearing parents and deaf children of deaf parents (Johnson, Liddell, & Erting 1989; Spencer, 1993a, 1993b).

For most deaf children to acquire language, it needs to be visible to them on the lips, faces, and/or hands of their communication partners. For some children, oral-auditory input may be sufficient. In interactions with their young children, parents often comment on things of mutual interest. Hearing children can listen to what the parents say while visually exploring relevant objects or observing events. Information from the two sources is received simultaneously, and a link is implicitly or explicitly created between language and the objects or events to which it refers (Pisoni, 2000). Because most deaf children are dependent on the visual modality for language reception regardless of whether they are acquiring a spoken or signed language, they have to shift attention between their activities and their language partners in order to obtain information both about what is going on around them and about language itself (e.g., Harris, 1992; Wood, Wood, Griffith, & Howarth, 1986). Input from these two sources is received sequentially, potentially making the link between language and meaning less obvious. Note that the introduction of sign language or a visually-supported spoken language is insufficient in this case, if other aspects of the linguistic environment are not also modified; for example, by ensuring that signs are made within the child's visual field, perhaps displaced on or near the object of attention (Erting, 1988; Mohay, Milton, Hindmarsh, & Ganley, 1998; Spencer, Bodner-Johnson, & Gutfreund, 1992).

Gregory and Barlow (1989) studied a group of deaf and hearing mothers, all with deaf infants, from the time the children's hearing losses were first diagnosed until they were 12 months of age. They found that deaf infants attended significantly more often to deaf mothers (94 percent) than to hearing mothers (75 percent). Further, the actions of deaf mothers were more likely to be followed by relevant actions by their deaf children (59 percent) than were the actions of hearing mothers (23 percent) indicating greater success in gaining and maintaining children's attention. Lederberg and Everhart (1998) pointed out that it is not that hearing mothers of deaf children produce less speech than hearing mothers of hearing children. They and others have found that hearing mothers produce comparable amounts of speech to deaf and hearing children, regardless of whether the mothers are using sign language and spoken language or just spoken language. Hearing mothers also modify their spoken language to deaf children in much the same way as hearing mothers do to their hearing children (see Gallaway & Woll, 1994, for a review). The problem is that young deaf children are unable to *benefit* from spoken language in any way comparable to hearing children, with the exception of some children who have cochlear implants. Conditions that support language acquisition through audition are not the same as those supporting language acquisition through vision, and qualitatively different strategies are required.

The quality of early parent-child interactions is largely dependent on communication skills. When deaf children must choose between watching their mothers or following their pointing, they invariably miss relevant information from one source or another. When hearing mothers attempt to gain their child's attention before communicating, they frequently do so in clumsy, intrusive ways that disrupt the child's activities (e.g., turning the child's face towards them). Hearing mothers have relatively smaller repertoires of visually-oriented attention strategies, tending to rely on object-related strategies which have only limited success (Jamison, 1994; Mohay et al., 1998; Waxman & Spencer, 1997). Therefore, the behavior of hearing parents with deaf children tends to be more intrusive and controlling than that of parents who share their children's hearing status (Henggeler, Watson, & Cooper, 1984; Musselman & Churchill,1993). They tend to resort to more physical control, whereas those who have established an effective channel of communication with their deaf children have less need for such control (Erting et al., 1990; Rea et al., 1988; Webster-Stratton & Hammond, 1988). Early intervention programs appear to reduce controlling behavior by parents, but even then, parents have difficulty manipulating situations in ways that effectively use visual communication strategies to optimize linguistic and environmental information available to the child (e.g., Greenberg et al., 1984; Lederberg, 1993). Hearing parents certainly can learn to use the strategies of deaf mothers in order to engage children who are deaf, but it requires that they constantly remember that their children depend on visual cues.

Generally, deaf mothers bring communication to their children, reducing the need for frequent shifting of attention. They provide more opportunities for their children to control interchanges, making language more interesting and more motivating (e.g., Harris & Mohay, 1997; Swisher, 1984). Children of mothers who control the language environment, regardless of whether they are deaf or hearing, are more likely to be delayed in language development as well as in cognitive and social development (e.g., Musselman & Churchill, 1991). The establishment of effective mother-child communication strategies, therefore, not only helps to promote better early interactions, but

has long-term beneficial effects on language development, social development, and cognitive development.

***Accommodating the Language Needs of Young Children Who Are Deaf***

In general, deaf parents show greater awareness of the communication attempts made by deaf children than do hearing parents (e.g., Spencer et al., 1992). This awareness results in part from their own experiences, but deaf parents also are likely to be more attentive to visual signals from their children and are likely to have more effective communication with them via sign language. Hearing parents clearly recognize the importance of effective communication for young children with hearing loss, including the quality of the visual signal and the appropriateness of the signing directed to the child (Ritter-Brinton & Stewart, 1992). Nevertheless, Young (1997) found that parents try to balance their desire for sign language proficiency with the "emotional and practical considerations" of the family. In practical terms, this means effective communication sometimes suffers, especially for hearing fathers, who tend to have poorer sign skills than hearing mothers (Gregory & Hindley, 1996).

Research with both deaf and hearing children typically has focused on mother-child communication. Calderon and Low (1998), however, found that among young deaf children of hearing parents, those children whose fathers were present in the home demonstrated significantly better expressive and receptive language skills, as well as superior early reading ability, relative to those with absent fathers.[4] Results of the Calderon and Low study emphasize the importance of including fathers in practical, theoretical, and research considerations involving young children who are deaf and hard of hearing. Several studies concerning the ways in which adults modify their language in communicating with young hearing children have found that both fathers and other adults who are not parents tend to adapt their language in ways similar to hearing mothers. Often referred to as *motherese*, the ways in which language is modified for young children depend on adults' beliefs about children's language capabilities, and are seen regardless of whether a child is hearing or deaf and regardless of whether signed or spoken language is used (Gallaway & Woll, 1994). When directed to young hearing children by hearing mothers, for example, language tends to be slower, grammatically simpler, and more likely to include shortened versions of words than is the language directed to older children or adults.

Because language development in deaf children of deaf parents occurs in a natural manner, we would expect that deaf mothers' use of motherese would begin just as early as it does in hearing mothers of hearing children, and this turns out to be the case. Deaf mothers use primarily single signs with babies during the first several months of life, frequently with the same kinds of repetition and sign shortening that is seen in hearing mothers speech to their hearing babies. Deaf mothers' motherese also tends to be accompanied by smiles, touching, and numerous mouth movements; and they use exaggerated facial expressions with their babies even more than hearing mothers (Snitzer Reilly & Bellugi, 1996; Snitzer Reilly et al., 1990).

In the case of hearing parents and infants, speech makes language available to the child regardless of whether they are looking in the right direction. Frequently, however, it appears that a deaf child

is not watching his mother, and many hearing mothers are reluctant to sign at those times. Deaf mothers also sometimes report that they resist signing to their children unless they have made eye contact, but they commonly move their hands out in front of their babies rather than moving a child's head or physically changing their position, so that the children will see their signs (Mohay et al., 1998; Wood et al., 1986). Over time, this strategy teaches infants to attend visually to cues in the environment, and deaf babies become remarkably good at attending to mother across a wider range of positions than do hearing babies. Indeed, there is evidence that deaf children are better at detecting visual events in the periphery of their vision than are hearing children (Swisher, 1993). This ability results from the fact that for these babies important things are happening on the "edges" of their visual range. Their eyes and brains adjust accordingly, with important implications for social and language development. The same phenomenon is seen in hearing children of deaf parents, who learn early that "interesting" visual signals occur in the periphery.

The ways in which parents accommodate to the language needs of their deaf babies thus seem to play an important role in determining the effectiveness of and interest in communication on both sides of the "conversation." Accordingly, we might expect that a lack of language flexibility and fluency on the part of hearing parents would reduce the quality of their social and early "educational" interactions with their deaf children. The implications for subsequent development may be considerable, and further examination of early language development needs to include consideration of social factors.

***Babbling by Deaf Babies – Language and Social Consequences***

Babies with normal hearing come into the world with the potential for hearing and producing a universal set of sounds and contrasts essential to spoken language. Not all languages, however, consist of the same basic elements. In Italian, for example, the pronunciation of a longer or shorter /s/ sound can make for two different words (*sposare* and *spossare)*. This difference is one that native English speakers do not hear without practice. Similarly, students of ASL initially are unable to see the difference between I AM ALWAYS SICK and I FREQUENTLY GET SICK. It is only over time and exposure to many examples that children learn the range of elements, either sounds or sign components, in their native language. Meanwhile, they gradually lose the ability to discriminate and produce language elements with which they have no experience. This process may explain, in part, why it is easier to learn a second language in early childhood than in adulthood, regardless of whether that language is spoken or signed. In this sense, the early ability to recognize the basic handshapes and movements of sign language thus seems to be comparable to the ability to recognize the basic sounds of spoken language (Schley, 1991). The information is different and is received in different sense modalities, but the characteristics of the information processor (the child) are much the same.

Hearing infants start to hone in on the sounds relevant to their native language during the first months of life, as evidenced in their babbling; but it typically is not until 7 to 11 months that hearing infants start to produce the well-formed syllables needed for babbling. At that point, sounds are repeated to form the first vocalizations that parents might interpret as words: "mama," "dada," and so on. This *repetitive babbling* is important both because it consists of the syllables that will be the

building blocks of words and because parents start responding to their children's apparent attempts at communication, leading to a new form of parent-child interaction.

Deaf and hearing infants do produce similar prelinguistic vocalizations like crying and cooing, but the two groups differ in their vocalizations before they reach the one-word stage. At around 7 months, when hearing babies are producing syllabic repetitions, and at around 10 months when their babbling becomes variegated (*/magamaga/*, */pakapaka/*), deaf babies are already showing a reduced frequency and complexity in vocal production. This difference occurs even when there is early use of amplification and concerted efforts to provide them with speech stimulation (Oller & Eilers, 1988). Residual hearing would be expected to reduce the babbling lag of hearing-impaired infants, but at least in those with moderate losses, the difference is still apparent. Repetitive babbling may still occur; but it appears later and occurs less frequently than in hearing children. Some investigators have reported vocal babbling in 2- to 5-year-old deaf children, but these vocalizations clearly differ from the babbling of hearing children who would have long since moved on to using words and phrases at that age.

The lack of complex early babbling by deaf children means that at the age when parents and siblings first start responding to their "communication attempts," deaf babies already may be at a disadvantage relative to hearing children. For the majority of deaf children, however, it is still too early for their hearing parents to suspect their hearing losses. It will be more than a year, on average, before those children are recognized as deaf and some form of early language intervention begins. Newborn hearing screening is changing this situation, but there is a long way to go.

Usually overlooked by hearing parents and researchers alike is *manual babbling*. Whereas vocal babbling consists of the combined vowel and consonant sounds that make up language, there are various forms that manual babbling could take. One of these would be the simple production or repetition of sign components, such as isolated handshapes or movements. Some of those movements actually constitute complete signs that are made by repeating simple handshapes and movements (Siedlecki & Bonvillian, 1993a). For example, in ASL the sign MOTHER or MAMA, is made by touching an open hand to the chin and is likely to occur spontaneously at some point. Such movements are not really signs from the child's perspective, but they are often interpreted as such by eager parents (see below). Another form of manual babbling resembles the combination of sounds seen in vocal babbling. Some young deaf children of deaf parents produce individual and repeated sign components, but with no apparent attempt at communication. This form of babbling has only been documented in a few children, but it may be a more general phenomenon.

Petitto and Marantette (1991) provided one of the more extensive examinations of manual babbling, studying three hearing children of hearing parents and two deaf children acquiring ASL from their deaf parents. They found that all of the children produced similar hand movements consisting of a subset of the potential elements of sign language. The deaf children's hand movements, but not those of the hearing children, also appeared to progress through the stages characteristic of vocal babbling, and were both more complex and varied than those of the hearing children. Further, 98 percent of the deaf children's manual babbling occurred within a restricted space in front of the body, which is the primary signing space. Petitto and Marantette concluded that young children discover the

relations between the structure of language and the means for producing language, regardless of the modality of input/output. Such findings appear to reflect both an innate predisposition to discover the patterned input of language (the perspective favored by Petitto and Marantette) and the social-environmental regularity of language acquisition. Regardless of the relative contributions of these two factors, the similarity of the manual activity produced by hearing and deaf children and their inclusion of handshapes that are the building blocks of sign languages argue strongly that babbling is intimately tied to the acquisition of language (see Battison, 1974)[5].

However one interprets the linguistic relation between deaf children's early handshapes and manual babbling, those behaviors provide motivation for deaf parents or hearing parents who sign to engage in "conversations" with their deaf infants in the same way that babbling prompts hearing parents to talk to their hearing infants. Eventually, the language-relevant parts of such babbling will become incorporated into communication and, along with meaningful gestures, deaf children will be well on the way to acquiring language. Manual babbling thus appears to be different from gesturing (but see Meier & Willerman, 1995; Schley, 1991; Volterra & Iverson, 1995), insofar as gestures are meaningful while manual babbling, by definition, is not. Early gestures play a vital role in early language learning and are worthy of consideration in their own right.

### Gestures, Signs, and Words

The focus of most research on deaf children's early manual behavior has been on their use of meaningful gestures rather than the components of those gestures that might be precursors of signs. Everhart and Marschark (1988) summarized a body of research showing that gestures accompany the speech of hearing children in much the same way as they accompany the signs of deaf children. When hearing children use gestures, we can easily distinguish them from words. The distinction is somewhat harder to make when deaf children mix gestures with their signs, because the two forms of communication share the same channel of communication, from hand to eye. Deaf children's gestures nonetheless may give us some insight into their language development and, later, into their cognitive development and behavior. We, therefore, need to look more closely at the relations among early gestures, early words or signs, and children's knowledge of the things to which they refer.

It is important to note that there is no evidence to suggest that the early use of gestures or signs by deaf children hampers their development of spoken English (e.g., Evans, 1988; Sharpe, 1985; Todd, 1976), nor is there evidence that early introduction to spoken English negatively affects later acquistion of signing.[6] As noted earlier, gestures appear to be an essential prelude to language development, establishing the rules and contexts of interpersonal communication for both deaf and hearing children (Bates et al., 1989). The available evidence indicates that, on average, deaf children who learn a sign language as preschoolers show better academic achievement and social adjustment during the school years, and superior gains in English literacy (Calderon & Greenberg, 1997; Gregory, Smith, & Wells 1997; Notoya, Suzuki, & Furukawa, 1994; Strong & Prinz, 1997). Thus, positive outcomes in the school years are related to the ability to communicate through language, whatever its form, from an early age.

### *The Role of Gesture in Early Language Development*

Young children's use of early gestures is generally assumed to pave the way for hearing and deaf children's eventual use of spoken words and/or signs (see Volterra & Erting, 1990, for surveys of each). When children who hear are at the point of using only single words (10 to 16 months), and when they move to using combinations of two words (16 to 24 months), gestures continue to play an important role in the language development. Likewise, there is no evidence to suggest that deaf children will depend on gestures to the exclusion of signed or spoken language when a more regular form of communication is available. Rather, for both deaf and hearing individuals, gestures are an essential component of communication during the first year of life and through adulthood (McNeill, 1992; Stokoe & Marschark, 1999). The questions of interest are how young deaf and hearing children use gestures and how they function within later verbal repertoires. Comparisons of the gestural systems of deaf children with those of hearing children are likely to be informative in this regard, insofar as they would reveal commonalities of early communication behavior that are eventually replaced by more conventional signed or spoken systems (see Volterra & Iverson, 1995). Like language, gestures initially develop in children because of the need to communicate their wants, needs, and desires (Bonvillian & Folven, 1993; Yoshinaga-Itano & Stredler-Brown, 1992); therefore, marked differences as a function of hearing status would not be expected. There appear to be several shifts in the frequency and purpose of gestures at various points of development, however, and these may differ as a function of early language exposure. Petitto (1987), for example, showed that among young deaf children of deaf parents, there is a noticeable change in use of pointing from its "immature" use as a gesture showing or requesting something, to a "mature" form in the personal pronouns of ASL like ME, HER, and YOU. At around 9 months of age, she observed both deaf and hearing children using pointing as a showing or requesting gesture. Then, at around 12 months, deaf children stopped using pointing to refer to people, although it still was used to refer to things and places. Six to twelve months later, person-pointing came back into use, but this time it was used as a sign to represent personal pronouns. Such shifts indicate that gestures and signs are distinct, even if they look the same, and indicate the need to examine more closely relations among early gestures, early signs, and early words.

The relation between early gestures and the first words has been of interest for a long time. The theoretical issue is this: If particular gestures are primitive forms of symbolic representation, one would expect that growth in speech or sign repertoires would be linked to a simultaneous reduction in gesture frequency. In contrast, if gestures and words serve similar functions, one would expect a positive relationship between gestural and verbal production in frequency as they shift away from being contextually bound to particular referents.

The role of gesture as a precursor to sign language and the correlation of gesture use and sign vocabulary size are particularly interesting, given the claims of several researchers that deaf and hearing children who learn sign language as a first language typically produce first signs earlier than peers learning spoken language as their first language produce their first words (see Meier & Newport, 1990, for a review). The issue of whether or not there is truly an advantage for sign language in early childhood will be considered below. Nevertheless, it is worth noting here that deaf children acquiring spoken language do *not* appear to use gesture with any greater frequency than do

hearing children. Deaf children acquiring sign language between the ages of 7 and 15 years, a period that has been well-researched, do use significantly more gestures than do hearing children during the school years, a difference that decreases but does not disappear over time. As the first words come to be used by children near the end of the first year, they do not replace gestures; rather these words tend to fill other roles in the language repertoire, regardless of whether the children are hearing or deaf (e.g., Caselli & Volterra, 1990). Later, the gestures used by older children and adults are not used in place of words or signs, but accompany them as a means of highlighting important information or specifying spatial relations (Marschark et al., 1991).

***First Signs, First Words***

The point at which *word* status is bestowed upon an utterance is largely a function of one's general orientation with regard to language. Several investigators, for example, have looked at the components of the manual movements made by young deaf children as a means of better understanding the transition from babbling to signing. Newport (1988) found that deaf children who acquire ASL as a first language recognize that signs and their inflections are two different components of a single unit (see also, Levy, 1997). This distinction is similar to the verb-inflection distinction made by hearing children acquiring English (e.g., *study+ing)*, but later learners of ASL who are deaf tend to view sign+inflection combinations (e.g., STUDY CONTINUOUSLY) as a single unit. While such holistic processing may be sufficient for the acquisition of vocabulary, it clearly is an inefficient means of acquiring a language, and would result in significant *undergeneralization* in language development.

Siedlecki and Bonvillian (1993a) examined the components of communicative manual movements among children of deaf parents (8 hearing, 1 deaf), aged 6 to 14 months. Their observations revealed that the children were most accurate in the locations of their earliest signs, followed by related movement, and then use of handshapes. They argued that this sequence also represents the order of phonological development within ASL, supporting a variety of their own findings and previous research in the area. Analyzing the same data, Siedlecki and Bonvillian (1993b) found that the deletion of one of the hands from two-handed signs at this age appeared comparable to that observed among deaf adults, although the likelihood of deletion varied across signs depending on whether or not the hands came in contact with the body. Siedlecki and Bonvillian (1997) further reported on the development of handshapes, finding their acquisition to be influenced by both the point at which handshapes normally contact the sign location and the physical position of the handshape within two-handed signs.

These findings demonstrate that a child's learning how to make signs, as in learning how to say words, may be separate from understanding the meanings of those words or how they might be used in a sentence (Levy, 1997). In a related study, however, Schick (1990) found that among a somewhat older group of deaf children of deaf parents, the use of a particular handshape was affected both by the morphological (i.e., structural) complexity of sign and the place of the sign within the syntax of the production. Thus, for example, handshapes were more accurate when the referent was a key element in the meaning than when it was of lesser importance. Her results rule out any explanation of the development of handshape use within ASL based simply on maturation and suggest a complex

interplay of physical and linguistic components of sign language development. Taken together, these studies provide interesting information concerning the earliest development of ASL, findings that could be helpful in examining the growth of vocabulary and the possible link between expressive language and the complexity of the language produced.

Several investigators have argued that the first signs of native-signing, deaf and hearing infants can be seen one to three months earlier than the first words of hearing peers, or somewhere between 7 to 9 months (Maestas y Moores, 1980; Orlansky & Bonvillian, 1985). Other investigators, in contrast, report the first signs emerging closer to 12 months, the same age as hearing infants produce first words (see Drasgow, 1998; Marschark, 1993, Chapter 5, for details concerning earlier research). It is difficult to know whether or not many of the early, parent-reported manual productions should be considered signs. Like the first words, parent-reported first signs tend to be rather simple approximations that, at least initially, could be spontaneous and nonlinguistic. One frequently-reported early sign, for example, is the sign MILK, made by the opening and closing of the whole hand. Flexing of the unformed hand undoubtedly occurs frequently in infants, and it seems only a matter of time before it is produced in an appropriate context, interpreted as a sign, and reinforced by providing milk. Nevertheless, the implications of such productions for social responding by others are exactly the same as those created by hearing children's first "words." Therefore, early productions may be advantageous for language development.

Acredolo and Goodwyn (1988) reported one relevant study in which they had the parents of hearing children include several symbolic gestures in their interactions with their children, beginning between 8 and 11 months of age. Although the small manual repertoire limits its generalizability to children receiving a full range of signed input, Acredolo and Goodwyn found a small but consistent advantage of just over two-thirds of a month in the appearance of manual over spoken productions. They concluded that although signs may have an edge as far as the emergence of expressive vocabulary, the small (and significant) differences observed should not be taken as conclusive evidence of a true sign advantage.

In an extensive review of the relevant literature, Meier and Newport (1990) considered a variety of studies on both sides of the sign advantage issue. They re-examined both theoretical and methodological aspects of previous investigations and concluded that the available evidence slightly favored a sign language advantage at the one-word stage of vocabulary development. Further, Meier and Newport and others have emphasized the fact that the component parts of signs – the distinctive features of the language – are visible to sign language learners. The visibility of sign features contrasts with speech, in which fewer components are readily visible without training for both producers and receivers. This visibility may provide an advantage for language development. Importantly, Meier and Newport reported that the sign advantage disappears by the two-word stage, when syntactic and semantic factors come into play, suggesting that there are likely multiple interactive mechanisms underlying early language development.

More recently, Volterra and Iverson (1995) described the sign advantage as "an artifact of a pattern of development in prelinguistic communicative gesture that is also observed in children not exposed to signed input" (p. 373). Volterra and Iverson suggested that because gestures of both deaf and

hearing children share the same modality as sign language, they provide a smooth transition to language in the visual mode. Thus, observers might be more likely to bestow linguistic status on the prelinguistic gestures of children in sign language environments relative to the gestures of hearing children in spoken language environments. Volterra and Iverson reported that in a study of 23, one-year-old hearing children exposed only to spoken language, twice as many gestures as words were observed. Gestures were found to appear at approximately the same age as children's first words, 10 to 13 months, rather than significantly earlier (cf. Bonvillian & Folven, 1993; Orlansky and Bonvillian, 1985). Gregory and Hindley (1996) also reported that the early gestures used by hearing children are less likely than those used by deaf children to be seen as "real" examples of communication.

***Relations Between Parent Language and Child Language***

In some sense, the possible existence of a sign advantage is of more scientific interest than pragmatic interest, insofar as it has not yet been shown to have any long-term impact on language development of deaf children. More important is the advantage that deaf children of deaf parents have in language development relative to deaf children of hearing parents, rather than the mode of that language (e.g., Nelson et al., 1993). As we have seen, when parents and children share the same hearing status and language, communication is far more accessible than it is when deaf children have hearing parents, both because of the visual availability of sign language and the use of appropriate communication strategies. The overall language advantages seen in deaf children of deaf parents, therefore, seem largely attributable to the language learning environment rather than to anything inherent in sign language *per se*.

Recent findings from a study by Pressman, Pipp-Siegel, Yoshinaga-Itano, and Deas (1999) are consistent with this suggestion. They studied the interactions of deaf toddlers with their hearing mothers from 21 to 30 months of age. A follow-up evaluation occurred approximately one year later. Although the children varied in their degree of hearing loss and their primary mode of communication, neither of these factors was reliably related to expressive language either at initial evaluation or follow-up. Rather, Pressman et al. found the strongest relationship between maternal sensitivity in interactions with the children and children's expressive language skills. They suggested that this relationship may derive from the extra flexibility and motivation necessary on the part of hearing mothers in order to compensate for their deaf children's communication needs (Lederberg & Mobley, 1990). In their words, "Mothers who do not get discouraged and withdraw from interaction when the children's language development is slow may contribute to a child's long-term success" (p. 301).

In a related study, Musselman and Churchill (1993) examined the language abilities of profoundly deaf children enrolled in either total communication (TC) programs or auditory-oral programs. The children were first seen when they were 4 ½ years of age and again when they were almost 7 years old. Musselman and Churchill found that the two groups did not differ in their expressive or receptive abilities, but those children with mothers who were less dominant in conversational turn-taking showed greater gains in expressive language growth, regardless of the original starting point of their language skills. Spencer (1993a, 1993b) further showed that despite large individual

differences, the sign production of deaf infants was significantly related to mothers' sign language production rates; and some young deaf children showed expressive language at rates fully comparable to their hearing age mates. Spencer argued that in early stages of language development, the establishment of meaningful relations between words (signed or spoken) and their referents is more important than grammatically correct constructions (see also Greenberg et al., 1984; Snitzer Reilly & Bellugi, 1996).

Such findings emphasize that young deaf children are not doomed to delayed language development as long as specific efforts are made to ensure their access to effective communication with language models. Calderon and Greenberg (1997), for example, reviewed literature concerning a variety of early intervention programs, and found that when children who are deaf are enrolled in such programs and receive early exposure to sign language, they demonstrate more competent language development than children who do not receive those interventions. Mayberry (1993) and Singleton, Supalla, Litchfield, and Schley (1998), among others, have found that earlier access to ASL as a first language is a primary predictor of ASL fluency through childhood and into adulthood. Other factors are clearly related to ASL fluency, including variables related to the children, their families, and the larger social environment. As children move beyond the earliest relationships within the family, these variables will take on greater significance. Outside of the home, children will encounter a greater range of language and other experiences that shape the course of later development. Those children who have effective communication skills will continue to develop and learn from formal and informal educational opportunities, whereas those children with poor communication skills will fall farther and farther behind throughout the school years.

## Building an Effective Language

Thus far, attention has focused on developing the broad essentials of language. In the following section, relations between learning language in spoken and signed modalities and the mapping of language onto the complexities of the world are considered. In those contexts, links between language development and cognitive development are discussed with an eye toward fostering literacy and academic success. In the discussion of deaf children learning to sign and learning to speak, the issue of cochlear implants should be considered and a section is included on this topic. Also, a later section addresses relations between sign language, spoken language, and English literacy.

Despite the long history of emphasizing spoken language in the United States, empirical research concerning the development and teaching of speech skills to young children who are deaf has lacked theoretical coherence and generalizability with regard to language use in every day conversation (Paatsch, Blamey, & Sarant, 2001; Shaw & Coggins, 1991; Tye-Murray & Kirk, 1993). Cole and Paterson (1984) reported that over half of all school-aged children in the United States and Canada with significant hearing losses had speech that was rated as unintelligible. More recent studies, involving children with cochlear implants, have demonstrated significant improvements in that regard, but unintelligible speech remains the norm for children with implants (Serry & Blamey; 1999; Tobey, Geers, & Brenner, 1994; Tye-Murray & Kirk, 1993). The acquisition of individual speech sounds, for example, generally proceeds in the same order for hearing children and children

with implants; but the process is slower for the children with implants, and those with congenital hearing losses rarely attain speech that is fully intelligible (Serry & Blamey, 1999).

Methods for teaching and evaluating the speech of children who are deaf have involved procedures such as the sampling of spontaneous conversation, evaluating the intelligibility of words produced in context, and tests of single-word articulation (e.g., Ling, 1976; Perigoe, 1992). A variety of studies have indicated that intensive speech therapy can lead to improvements in various aspects of speech production by children who are deaf, but "developing completely intelligible speech in children with profound hearing impairment remains a challenge" (Paatsch et al., 2001). In part, this situation may result from the fact that most research in this area has been aimed at evaluating only a single means of speech therapy; thus we lack information concerning the relative utility of different approaches (Moores, 1996) or the possibility of combining them.

Further, because of the emphasis on speech reception and production rather than language development per se in children who are acquiring spoken language, we actually have more information concerning the development of sign language than the development of spoken language in children who are deaf. This situation makes it difficult, if not impossible, to fairly evaluate the relative merits of spoken language versus sign language for young deaf children, especially with regard to semantics, grammar, and more complex aspects of language. There is one safe conclusion however—neither spoken nor sign language is inherently better than the other. We must consider all of the needs of deaf children in various developmental and educational contexts in order to make appropriate decisions on an individual basis.

As deaf children move into preschool and other settings outside of the home, they usually have more varied language experiences with more partners, and the language learning context becomes more complex. For example, when young deaf children of hearing parents and their hearing parents are learning sign language, the children often acquire it at a faster rate than their parents. One factor contributing to this situation is that once these children enter a preschool program, they are exposed to far more sign language, and more naturally produced sign language, than are their parents. It would be the rare hearing parent who had the time to spend four to six hours a day in a room where signing was the primary means of communication.

A second factor affecting the rate of sign language learning is that deaf children are far more dependent on signing than are their hearing parents. For many deaf children, sign communication is the most efficient way to express their needs, desires, curiosity, and creativity. Their parents, in contrast, have a full range of spoken language at their disposal. This situation is unfortunate in some ways because hearing parents and teachers of deaf children often do not realize that they are saying far more in their speech than in their signing. The problem is not that the signs cannot express the same information, it is just that greater fluency in speaking tends to overpower one's signing ability. Language ability varies, of course, but the available evidence indicates that even in the classroom, 25 to 50 percent of a spoken message may be omitted from the signing of teachers who report that they are using simultaneous communication (e.g., Johnson, Liddell, & Erting, 1989). Even more troubling are those cases in which people say one thing and incorrectly sign something else. Not only is there no real communication in that case, but the child is faced with erroneous information about

which signs mean what. Many deaf children thus not only start learning language later than peers who share a language with their parents, but they are confronted with less consistent and less useful language experiences when they do start.

***Learning to Use Language Efficiently***

Before explicitly considering linkages between sign language and spoken/written English, it is important to examine the syntax and semantics of early language development. The focus of this subsection is on the acquisition of sign language as the primary mode of communication for deaf children because, as noted above, comparable research findings are not available with regard to spoken language for deaf children (Moores, 1996). Regardless of the mode of communication, however, the process of building language fluency would be the same as long as a child has effective access to language input and feedback concerning language production. Most importantly, the way in which early knowledge/meanings are organized and interconnected depends on the quality and quantity of language interactions and will play a central role in later literacy skills (Risley & Hart, 1995).

During the preschool years, from age 2 to 5, deaf children who are naturally exposed to signing in the home rapidly increase the frequency with which they use conventional signs to communicate about objects and actions. In addition to the accumulation of new signs, modifications of existing signs also enhance the preschooler's ability to communicate with others. Deaf 2-year-olds exposed to ASL, for example, appear to understand conventional sign modifications such as verb inflections, and by age 3 they are modifying signs themselves. The early modifications produced by those children generally do not conform fully to the rules of ASL until they are closer to 5 years old. Nevertheless, deaf 3- and 4-year-olds clearly know that signs can be altered to modify their meanings. Most of their modifications make sense, and, like the spoken modifications of words produced by hearing children, there is remarkable consistency across children (e.g., Newport & Ashbrook, 1977).

The order in which new aspects of language are learned by deaf children of hearing parents is consistent with that of hearing children of hearing parents and deaf children of deaf parents, even if it tends to lag some months behind. There are differences in what children know *about* individual word concepts, and significant differences in the organization of lexical knowledge can be found even among deaf college students (e.g., McEvoy, Marschark, & Nelson, 1999). As with hearing children, however, deaf 3- and 4-year-olds *overgeneralize* some signs. Hearing children of this age frequently overgeneralize irregular verbs and nouns that they previously used correctly. Thus, *fell* becomes *falled* and *children* becomes *childrens*, presumably because they have learned the general rule and attempt to make similar words conform to that rule. Deaf children similarly overgeneralize, for example, by adding direction to nondirectional verbs such as TOUCH or DRINK, giving them understandable points of origin and conclusion. Overgeneralizations of this sort are well understood by others when they occur in children's signing and speech, and they may be responded to or corrected by others around them. Whatever their reaction, we need to recognize the importance of such "errors." They indicate that the child is making sophisticated guesses about the grammar of the language and acquiring its component rules.

During the second half of their fourth year, when deaf signing 3-year-olds begin to modify verb signs, they first use inflections to communicate directions and locations. They then begin to include qualitative and quantitative inflections in their signs, indicating how big, how good, how bad, or how fast something is. By age 4, they are modifying signs and their meanings through conventional ASL facial expressions as well as inflections to indicate subjective meaning. In short, 4-year-old children who learn sign language early are fully able to express how and why things occur, their goals and intentions, their likes and dislikes. They are well on their way to learning the grammatical and discourse rules of ASL.

Several recent studies have emphasized *pragmatic* aspects of deaf children's language development. Ciocci and Baran (1998), for example, found that 4- through 7-year-old profoundly deaf children of hearing parents were just as competent as their hearing peers in responding to requests for clarification in conversation. Clarification strategies are an essential component of social conversation, and it is important to demonstrate that young deaf children possess this skill.

Jamieson (1995) had profoundly deaf 4- and 5-year-old children perform a construction task with their deaf mothers and observed the language the children signed or spoke to themselves. Consistent with the frequent observation that deaf children of deaf parents appear to have an overall language advantage relative to deaf children of hearing parents, she found that deaf children with deaf mothers used more mature "private language" than deaf children of hearing mothers. Cook and Harrison (1995) also examined the private language of deaf preschoolers. They found that deaf children sign rather than speak to themselves while looking at books, writing, and playing alone; and children who were more advanced in their literacy skills used more private sign language both at home and at school. These studies point to the need for additional research concerning the pragmatic language skills of deaf children during the school years. Most language research involving such children has focused on the acquisition of literacy skills, but interest in conversational and broader uses of language is growing.

***Does Learning to Sign Affect Learning to Speak?***

Educators have questioned for years whether teaching young deaf children sign language will impair their ability or motivation to acquire spoken language. There is no empirical evidence to suggest that this is true. Several observers have indicated that ASL grammar sometimes intrudes into deaf children's speech and writing (e.g., Charrow, 1976; Todd, 1976). Such intrusions are common among children and adults learning a second language. An equally important question is whether learning to speak affects learning to sign. There are no reliable data indicating any particular difficulty with regard to learning sign language.

Geers and Moog (1978) argued that approximately 90 percent of severely and profoundly deaf children could achieve proficiency in expressive and receptive spoken language under optimal conditions. Those conditions include strong family support, an educational program strong in support for oral and aural information, and at least average intellectual ability. There is, however, limited research on the percentage of deaf children who develop spoken language skills that are

adequate for the practical purposes of day-to-day life and little is known about the characteristics of those who do reach those levels of proficiency.[7] Gregory and Hindley (1996), among others, therefore, have emphasized the need for the availability of alternatives for young children who are deaf.

Geers, Moog, and Schick (1984) examined the signed (manually coded English) and spoken English grammar skills of 168 deaf children enrolled in programs emphasizing spoken language and 159 enrolled in total communication (TC) programs. All of the children were between 5 and 9 years of age, had profound congenital or early onset hearing losses, and had been involved in early intervention programs. Geers et al. found no significant differences in English grammar skills between the oral and TC groups when the latter children used sign only or when they used speech and sign together. At the same time, the TC group showed significantly poorer spoken language performance than sign language performance (see also, Geers & Moog, 1992). Geers and Schick (1988) re-examined a subset of the children from that earlier study, comparing children who had deaf parents with those who had hearing parents. Among 5- and 6-year-olds, Geers and Schick found essentially no differences between the groups in either spoken or signed English ability. However, by 7 and 8 years the children of deaf parents showed small but reliable advantages in both modalities.

Daniels (1993) specifically suggested that hearing preschoolers learning ASL as a first language might have an advantage in the acquisition of English vocabulary. She tested 14 hearing children of deaf parents, aged 2 to 13 years, on the Peabody Picture Vocabulary Test (PPVT) and found they obtained significantly higher scores than would be expected on the basis of the PPVT norms. While generalizations across the wide age range examined are difficult, Daniels' results indicate that the availability of spoken and signed language at an early age facilitates expressive vocabulary. That conclusion is supported by results from two cases reported by Notoya et al. (1994). They examined vocabulary growth and sentence production, in both signed and spoken Japanese, of two 4-year-old profoundly deaf children enrolled in a TC program. Acquisition of signed vocabulary was found to outpace spoken vocabulary, and was fully comparable to the rates of vocabulary growth in hearing peers through the stage of producing three-word sentences. Six months later, both children's reading scores on the Infantile Reading Achievement Test were found to exceed those expected from hearing children (see Musselman, 2000, for a review).

Dodd, McIntosh, and Woodhouse (1998) examined speechreading ability, speech skills, and language development in 16 preschoolers with severe to profound hearing losses. Assessments conducted over a three-year period indicated that children's early speechreading skills were strongly related to the development of spoken and sign language skills. Schick (1997), however, demonstrated that the quality of English language production by deaf students can vary considerably depending on the kind of production elicited (see also, LaSasso, 1999).

Together with a variety of case studies showing that the exposure to simultaneous communication yields positive results with regard to language development for children whose parents are skilled signers (see Lederberg & Spencer, 2001, for a review), these results suggest that the combination of sign language and spoken language still has significant, untapped potential (Mayer & Akamatsu,

1999). Arguably, we have not yet seen academic outcomes significantly enhanced by the use of TC, but the available findings appear to augur well for bilingual educational initiatives involving sign language and some form of English-based signing (LaSasso & Metzger, 1999; Mayer & Akamatsu, 1999; Wilbur, 2000). Although bilingual programs may not be as effective for English literacy as some have expected (see below), Wilbur (2000) and others have suggested that these programs ultimately may contribute to improved spoken language abilities as well. Studies concerning language development in children who are hard-of-hearing would be particularly enlightening in this regard. Despite the fact that there are many more hard-of-hearing than deaf students in the nation's schools, and hard-of-hearing students are at risk for language acquisition problems, such studies are rare.

In one such study, Preisler and Ahlstroem (1997) followed 15 profoundly deaf and 12 hard-of-hearing 2- through 7-year-old Swedish children over a two-year period. Analyses of the children's spontaneous language suggested that for the hard-of-hearing as well as the deaf children, acquisition of sign language resulted in frequent and complex use of language in social interactions while contributing to healthy social-emotional development. In another study, Elfenbein, Hardin-Jones, and Davis (1994) analyzed the spoken English of 40 children, age 5 to 18 years, with mild to severe hearing losses, and a comparison group of 16 hearing children. Using the grammatic completion subtests of the Test of Language Development (TOLD), they failed to find any differences between the two groups with regard to verbs, bound morphemes (inflections), or total score. Language samples obtained through an interview, in contrast, revealed significant differences in favor of the hearing children in semantic, syntactic, and pragmatic aspects of language use, even though the children with hearing loss "did not approach the severity of language skill deficits typically reported for children who have profound hearing losses" (p. 223). Elfenbein et al. reported that children with more mild hearing losses (i.e., < 45dB) performed similarly to hearing children, while those with more severe losses accounted for the overall differences between the larger two groups. They suggested that differences between the two groups derived largely from the deaf children's lack of knowledge of conversational discourse rules.

Marschark, Mouradian, and Halas (1994), in contrast, demonstrated that deaf and hearing children, aged 7 to 15, were fully comparable in their use of discourse rules. Using an analysis based on the meaning underlying stories, they found that signed and written productions of severely to profoundly deaf children were well-structured semantically, even though their written productions were far less competent than the written productions of hearing peers in terms of English grammar and vocabulary.[8] Marschark et al. suggested that the lack of English fluency normally might mask coherent thematic expression in deaf children's school writing and give the impression of relatively poor discourse skills. The finding that the deaf children demonstrated knowledge of the discourse rules necessary for writing, as well as for normal conversation, indicated that their general language abilities were independent of specific English subskills and comparable to those of hearing age mates, at least in this domain.

The above studies suggest that sign language and spoken language should not be considered as mutually exclusive alternatives, but as potentially additive strategies for encouraging language development in children with hearing loss. Hearing children use either gestures or words for

particular concepts, and deaf children use gestures, signs, or spoken words. This suggests a general developmental resistance to simultaneous communication *per se*, an inclination for young children to use only one mode of communication at a time (Geers et al., 1984; Jensema & Trybus, 1978). In both later childhood and adulthood, some deaf individuals are more comfortable with spoken language than others, and some are more comfortably and competently bilingual than others. Deaf children's relative fluencies in the two modalities will depend in part on the age of onset and the degree of their hearing losses. Other factors, such as parental language abilities (signing by hearing parents, speech and signing by deaf parents), and the quality of early education and exposure to spoken and signed language also may make a difference. Speech and sign skills often become increasingly intertwined in children who have experience with both modalities, improving speech production and comprehension as well as overall language ability.

In summary, neither spoken language nor sign language has been shown to be a panacea for the observed lags in the language development of children who are deaf. At the same time, it is well established that children raised in bilingual or multilingual spoken language environments have greater language competence relative to children from single-language environments (see Gregory et al., 1997). There are also some indications that early acquisition of sign language can foster English language skills, both spoken and written (LaSasso & Metzger, 1999; Mayer & Akamatsu, 1999; Wilbur, 2000).

***Cochlear Implants and Language Development***

One group of children for whom the combination of spoken language and sign language appears especially likely to be important is young deaf children who have received cochlear implants. Cochlear implants are performed at more than 250 specialty clinics and major medical institutions around the country. Implant teams include otologists, otolaryngologists, audiologists, speech-language pathologists, psychologists, educators, social workers, computer scientists and engineers; and also may include community advocates.

> A cochlear implant is a small complex electronic device that can help to provide a sense of sound to a person who is profoundly deaf or severely hard of hearing. The implant is surgically placed under the skin behind the ear.
>
> An implant has four basic parts: (1) a microphone, which picks up sound from the environment; (b) a speech processor, which selects and arranges sounds picked up by the microphone; (c) a transmitter and receiver/stimulator, which receive signals from the speech processor and convert them into electric impulses; and (d) electrodes, which collect the impulses from the stimulator and send them to the brain. An implant does not restore or create normal hearing. Instead, under the appropriate conditions, it can give a deaf person a useful auditory understanding of the environment and help him or her to understand speech.
>
> A cochlear implant is very different from a hearing aid. Hearing aids amplify sound. Cochlear implants compensate for damaged or non-working parts of the inner ear.

> When hearing is functioning normally, complicated parts of the inner ear convert sound waves in the air into electrical impulses. These impulses are then sent to the brain, where a hearing person recognizes them as sound. A cochlear implant works in a similar manner. It electronically finds useful sounds and then sends them to the brain. Hearing through an implant may sound different from normal hearing, but it allows many people to communicate fully with oral communication in person and over the phone.
>
> Both children and adults can be candidates for implants. Approximately 25,000 people worldwide have received implants. In the United States, some 14,000 people have implants; about half of these are adults and half are children (NIDCD, 2000).

For children with cochlear implants, signing may be an important accompaniment to spoken language, as many children with implants function more like hard-of-hearing children than hearing children. Meyer, Svirsky, Kirk, and Miyamoto (1998), for example, examined the progress up to 8.5 years post-implantation of more than 70 children who had received cochlear implants and two comparison groups using hearing aids, one group having 90-100 dB hearing losses and the other group having 101-110 dB hearing losses. The implanted children, all enrolled in a spoken language program, increased from 50 percent (chance) performance on an auditory perception test to 65 percent (just above chance) approximately one year later, approaching the performance level of the group with lesser hearing losses.

In regard to cochlear implantation, carefully-designed research continues to be needed on how receptive and perception skills are supported by and related to the unique auditory stimulation provided by an implant, the impact on language development, the social-emotional impact of implantation, and the long-term effects of cochlear implantation in children. Limited research was available for inclusion in this synthesis.

Geers and Moog's (1994) study of 13 children with cochlear implants demonstrated advantages for those children in a variety of language domains, relative to both hearing norms and comparison groups using hearing aids or tactile aids. Children with implants showed greater linguistic complexity in spontaneous language and larger expressive and receptive vocabularies and, overall, demonstrated expressive and receptive language skills above the 60th percentile relative to normally hearing children after 36 months with the implant and intensive auditory-oral instruction. Consistent with the later findings of Meyer et al. (1998), noted above, Geers and Moog found that the language abilities of the children with the implants, all of whom were considered good candidates for acquiring spoken language and whose hearing losses averaged 118 dB, closely resembled the abilities of deaf children with hearing losses of 90-100 dB and who used hearing aids.

Tait and Lutman (1995) studied another group of children with implants over a 12-month period. Three groups of nine children were studied, all of whom had little or no speech when first assessed either just after implantation or upon entry into nursery school. One group of children had received implants, one group included children who were predetermined to be getting "good" benefits from hearing aids, and a third group included children who were predetermined to be the getting "poor"

benefits from hearing aids. Overall, children in the implant group and the good hearing aid group were reported to have developed "oral communication," with the cochlear implant group improving their oral skills much more rapidly than the hearing aid users. Importantly, Tait and Lutman noted that eight of the nine children with implants had become deaf between the ages of 5 months and 2 years-8 months, whereas all of the children with hearing aids had congenital hearing losses. The possibility that early auditory stimulation contributed to the development of spoken language for these children suggests caution in interpreting the findings.

Vermeulen, Beijk, Brokx, van den Borne, and van den Broek (1995) conducted two studies directly relevant to the Tait and Lutman findings. Experiment One involved ten deaf children, all of whom had received cochlear implants--six who had lost their hearing at a mean age of 2.9 years, two who had lost their hearing at 5.5 years, and two with Usher's Syndrome. The children who had lost their hearing later were reported to show much better improvement in speech perception than the other children, but analyses were not reported for separate groups. Experiment Two involved 37, "mostly prelingually deaf" children, all 4 to 7 years old and enrolled in an oral program. The children either used hearing aids or had cochlear implants (12 months post-implantation) but it is not clear how many children were in each group. Overall, children with cochlear implants showed better spoken language skills than children with hearing aids but, as in the Tait and Lutman study, the children with cochlear implants were mostly post-lingually deaf whereas those with hearing aids were mostly prelingually deaf.

O'Donoghue (1996) evaluated the first 38 children to receive cochlear implants at the implant center involved in the earlier Tait and Lutman (1995) study, and thus presumably the same children. Children in the larger sample had been age 2 to 11 years at implantation and the length of hearing losses at the time ranged from 1 to 11 years. O'Donoghue's subgroup, however, consisted of children who were age 2 to 4 years and "pre-verbal prior to implantation." He found that 60 percent were "using speech effectively in everyday communication" two years after implantation, and 91 percent were doing so three years post-implantation. Although no other information is given on the younger subgroup, it seems likely that they were in the post-lingually deaf group described by Tait and Lutman, who had varying amounts of auditory experience prior to their hearing loss. With regard to the larger sample, O'Donoghue noted that teenagers were the least likely to benefit from implants, suggesting that this resulted from their lower likelihood of developing speech comprehension without reliance on speechreading, having already established signed communication and being more influenced by peer pressure.

Dawson, Blamey, Dettman, Barker, and Clark (1995) examined 13 adolescents and adults who received implants at age 2 to 20 years and had been using them for between 6 months and 7 years-8 months at the time of the study. Dawson et al. found that vocabulary scores increased significantly for the entire sample, but results were not reported for the different age groups. Age at implantation was not significantly related to improvement and only three children had reached age-appropriate vocabulary levels.

McConkey-Robbins, Osberger, Miyamoto, and Kessler (1995) evaluated the expressive and receptive language development of 15 deaf children at 6 and 15 months after implantation. All of

the children had been implanted at an average of 5 years-6 months of age, already past the most critical years for language development. Nevertheless, they found that language development at both ages exceeded expectations based on pre-implantation language abilities, with a larger increase occurring at the second testing. Due to the fact that there was no comparison group of deaf children without cochlear implants, McConkey-Robbins et al. (1995) were able to conclude only that the implants promoted language development "to a greater extent than would be predicted through maturation alone" (p. 165).[9]

Tomblin, Spencer, Flock, Tyler, and Gantz (1999) evaluated the English language achievement of 29 prelingually deaf children who received their implants between 2 and 13 years of age and had them at least three years prior to testing. The achievement levels of the children were compared to those of another group of deaf children, aged 3 to 14 years, who wore hearing aids. Twelve of the children in the implant group were tested earlier as part of the hearing aid group (as implant candidates). On measures of signed and spoken sentence comprehension, children with implants scored significantly above available norms, and language abilities of all but one child improved to the point where they were "no longer linguistically comparable to deaf children using [hearing aids]" (p. 501). On a test of expressive English grammar abilities, the children with implants again scored significantly better than the children with hearing aids, when controlled for age (see also Spencer, Tye-Murray, & Tomblin, 1998). As the investigators pointed out, most of the children in their study continued to use simultaneous sign and voice communication after receiving implants, and 70 percent of the words produced in the storytelling task were spontaneously produced in both sign and speech. Children with implants produced an average of 23 percent of the words with voice only and 6 percent of the words with sign only. Children with hearing aids, in contrast, produced 5 percent of the words with voice only and 23 percent of their words with sign only.

Waltzman, Cohen, Gomolin, Green, Shapiro, Brackett, and Zara (1997) obtained similar results in a study involving 38 children (but no comparison group). All of the children were profoundly deaf, had been implanted prior to age 5, and had used their implant for a minimum of one year. All except one, who used TC, had been exposed primarily to spoken language. Waltzman et al. observed significant increases in vocabulary development as well as production, relative to pre-implantation baselines. Over a 36-month period, expressive vocabulary increased by 48 months and receptive vocabulary by 33 months.

The above research clearly indicates that cochlear implants improve speech perception at frequencies that contribute to language processing, and that some children benefit more from implants than they would be expected to from hearing aids. Findings indicate that vocabulary growth is enhanced by cochlear implants, at least for children who have had some exposure to auditory input prior to hearing loss, and speech and language continue to improve (in children) the longer implants are in place. Many implant candidates are chosen for their apparent aptitude for spoken language; therefore, it also might be expected that such children will experience greater benefits than children with lesser spoken language skills. However, it is difficult to separate this factor from length of auditory experience prior to implantation, and controlled studies in this regard are not yet available. It is important to continue to identify the characteristics of children most likely to benefit from implants and how implants affect social and academic functioning.

One recent study evaluated the benefit of implants in terms of the cost of educating deaf children (Francis, Koch, Wyatt & Niparko, 1999). The investigators examined the correlation between length of experience with a cochlear implant and the rate of mainstream and separate settings. They found correlations of .10 and -.10 between the length of time that children had implants and the time spent in mainstream classrooms and special classrooms, respectively. More peer-reviewed research is needed in this area with children at differing ages of implantation, differing communication exposures, and differing intervention strategies. As the numbers of children who have received cochlear implants are increasing, more research will be needed on the best interventions for each sub-group of children. The research challenge, however, is that each child brings a unique set of variables (e.g., onset of hearing loss, degree of hearing loss, and communication environment).

## Language Development and Academic Implications

Understanding the impact of language skills on academic performance for children who are deaf clearly needs to include research pertaining to the access to classroom information through sign language interpreters, closed captioning, and other technologies. Unfortunately, relatively little research has been done in this area. In the case of interpreting, for example, a large number of surveys have demonstrated the need for educational interpreters (e.g., Baily and Straub, 1992). Other studies have evaluated the skills and characteristics (e.g., personality and intelligence) of interpreters (e.g., Winston, 1994). Nevertheless, only limited information is available concerning the quality of educational interpreting because we have not yet studied factors that influence comprehension of the interpreted message. The *Annotated Bibliography on Interpretation*, compiled by Patrie and Mertz (1997), lists more than 600 documents pertaining to sign language interpreting. Yet, its index contains no entries relating to children, learning, or the comprehension of signed material; and the one entry on "language acquisition" relates to interpreters' acquisition of ASL as a second language rather than the influence of interpreting on language development in deaf children.

Educators also have discussed the potential benefits and challenges to deaf children accessing print through visual or text telephones (TTYs or TTDs), closed captioning, speech-to-print software, and computers. It is widely assumed, for example, that captioned materials and other such technologies should facilitate the acquisition of English literacy skills of deaf children (e.g., Schirmer, 2000). However, the positive impact of captioning on language development and literacy in young deaf children remains a common assumption without much empirical support. Both captioning speed and language level are likely to influence comprehension of information captions and, by extension, their utility in fostering growth in language and literacy skills. Meanwhile, because TTY messages and captioning contain frequent spelling errors, appear only in uppercase letters, and are frequently ungrammatical, the impact of captioning on reading could be far less than is often claimed.[10] Only when relevant research findings become available will it be possible to determine the effects of such technologies on language and literacy development or determine how best to use them to the educational advantage of children who are deaf. Even then, such technologies will be only as good as the programs and teachers that employ them.

***Language Development and Cognitive Growth***

A variety of information has been obtained from investigations of the cognitive abilities of deaf children (see Marschark, 1993, Chapters 7-9, for a review). Most of the relevant studies, and especially the earlier ones, were aimed at understanding cognitive development "in the absence of language." Recent studies have dealt more directly with cognitive skills in children who are deaf, sometimes including evaluation of influences of language fluencies, mode of primary language, and degree of hearing loss (e.g., Braden, 2001). Still at issue are the ways that deaf children's atypical histories of language functioning and educational experience, both inside and outside of the classroom, might influence their cognitive development.

Early investigations of deaf children's intellectual functioning routinely found them to lag behind their hearing peers by several years (see Marschark, 1993). However, many of the tests used to measure intellectual functioning required comprehension of English, and there were rarely acknowledgments that such evaluations might be biased. More recently, various tests of cognitive ability have been developed that are nonverbal or that can be administered through sign language. Nevertheless, confounds between language development and the content and format of such testing remain problematic (e.g., Braden, 2001). Similarly, research focusing on specific aspects of cognitive development, such as classification and concept learning, have yielded contradictory and confusing results. Nonverbal paradigms sometimes have eliminated differences between deaf and hearing children on these tasks, but in other cases, significant differences remain. Delays in these cognitive domains have been demonstrated both in children who have been educated in spoken language environments and those exposed primarily to sign language.

One might expect that deaf children of deaf parents would perform comparably to hearing children of hearing parents on most cognitive tasks, but these expectations do not materialize with any consistency. Such findings suggest that there are factors beyond the language delays observed in many deaf children that contribute to or are reflected in evaluations of cognitive development. Those results also appear to rule out any simple causal link between language and cognitive abilities in deaf children. However, it may be that the ranges of language skill examined have been too narrow to evaluate the issue fairly. Of primary interest in this regard would be the quality and quantity of language-based interactions that, *a priori*, would be expected implicitly or explicitly to foster various components of cognitive growth.

For example, we know that early access to language is essential for normal cognitive development and academic success in both deaf and hearing children (Calderon & Greenberg, 1997). Bebko and his colleagues (e.g., Bebko & McKinnon, 1998; Bebko & Metcalfe-Haggert, 1997) have found that children's language development also is the best predictor of success in various memory tasks. Bebko and McKinnon (1998) found that for deaf children, the number of years of effective language exposure in their preferred modality fully accounted for the differences in memory for language at different ages, while the total number of years of language experience was not as good a predictor. Bebko and Metcalfe-Haggert (1997) demonstrated that the contribution of developing language skills, and especially *automatized* language skills such as the activation of word meaning, is an essential contributor to other complex cognitive abilities. Taken together, such findings emphasize

the need for care in evaluating language development, cognitive growth, and academic performance while recognizing that they are rarely independent.

In this regard, LaSasso (1999) specifically warned of differences in the test-taking strategies and skills of deaf and hearing students related to reading strategies, test format, and the type of information assessed. Students who are deaf are more likely to depend on visual (verbatim) matching on text-based tests, for example, and the way in which test questions are written thus may affect performance whether or not the students understand the content of material on which they are being evaluated. Deaf students also may be more likely than hearing peers to guess at answers in problem-solving situations rather than working through alternatives (Marschark & Everhart, 1999). This results in lower performance that may not reflect either their content knowledge or their ability to use problem-solving strategies. Maintaining or integrating verbal information over short periods of time is nonetheless essential for many academic tasks, and for reading and writing in particular. Such strategies, therefore, need to be fostered, or taught, if we want to optimize academic progress among students who are deaf.

***Language, Language Mode, and the Bridge to Literacy***

In 1988, the Commission on Education of the Deaf noted that "The educational system has not been successful in assisting the majority of students who are deaf to achieve reading skills commensurate with those of their hearing peers" (p. 17). Current data still indicate that less than half of the 18-year-old deaf students leaving high school have reached a fifth grade level in reading and writing skills (Traxler, 2000), and over 30 percent of those students leave school functionally illiterate (Waters & Doehring, 1990). Although language development and learning continue into adulthood, they are rarely studied after the school years. Yet, there are clearly many deaf adults and children who are excellent readers and excellent writers. What accounts for these differences? While there are many factors involved in answering this question, only some of those relating to language development *per se* will be considered here (see Paul, 1998, for a broader discussion).

In order to understand fully the challenges faced by young readers who are deaf, it is important to take into account the variation among those children as language learners, the influences of early language environments, and interactions of hearing loss and access to reading-relevant information, among other variables. A large portion of the effort devoted to improving literacy among children who are deaf has been directed at teaching them the skills and strategies that work for hearing children, even though it is apparent that deaf and hearing children often have very different background knowledge and learning strategies and cannot learn English in the same way (Singleton et al., 1998). Bowe (1998) expressed his concern about this situation and the attempts to *teach* language to deaf children rather than *support* their learning. He suggested that schools make use of all possible strategies to encourage reading during childhood in order to promote the natural acquisition of both language and English literacy among younger deaf children. Older children, he argued, can be taught particular language skills later, in one modality or another.

A report from the National Institute on Deafness and Other Communication Disorders (1995, p. 37) states that deaf children of deaf parents often are better readers than deaf children of hearing parents.

Studies supporting that suggestion have been reported by Singleton et al. (1998), among others, most of which remain unpublished. The relationship is not a particularly strong one, in any case, and the evidence is rather inconsistent (e.g., Akamatsu et al., 2000; Strong & Prinz, 1997). Even in studies where that finding has been obtained, the causes were unclear. Regardless of whether their parents are deaf or hearing, deaf children who are better readers had their hearing losses diagnosed earlier, had early access to language (usually via sign language), *and* were exposed to English (see Calderon & Greenberg, 1997; Mayer & Wells, 1996). Having a mother who is a good signer during her child's early years similarly has been found to be more important than whether she is deaf or hearing and more important than the precise age at which a child learns to sign. Deaf children of deaf parents, therefore, may well read better than deaf children of hearing parents, if their parents read with them regularly, ensuring understanding through sign language (e.g., Andrews, Winograd, & DeVille, 1996). Hearing parents who learn to sign well also can have a powerful impact on their children's reading abilities; however, a high level of proficiency in ASL is rare among hearing parents of deaf children (Young, 1997).

Clearly, we should not expect to find any single predictor of reading success that works for all children, deaf or hearing, and the combinations of factors that positively and negatively influence reading development are not yet fully understood. It may be, for example, that different environments lead to different strengths and weaknesses depending on when, where, and from whom children learn their first and second languages (Musselman, 2000). For example, deaf children of hearing parents tend to have better speech and speechreading abilities than peers with deaf parents, but those abilities do not seem to predict better reading (Wilbur, 2000). It also is tempting to assume that early exposure to language from parents who are deaf would provide a considerable advantage in learning to read for children who are deaf, and there have been several suggestions that English gloss of ASL (written translation) might be helpful in this regard (see Singleton et al., 1998). This potential advantage may be offset, however, by the fact that ASL vocabulary and syntax do not parallel those of printed English. This situation supports the suggestion that early exposure to both ASL *and* some form of manually coded English or cued speech might be more beneficial for the reading abilities of deaf children, giving them the advantage both of early exposure to language and English-relevant experience.[11]

Theoretically, exposing children who are deaf to some form of English-based signing as well as ASL should provide a bridge to written English, albeit with a stronger language base than when children are exposed only to simultaneous communication. Too often, however, educators have assumed that English-based signing is sufficient, in itself, to provide the language necessary for social and academic functioning. A variety of findings clearly indicate that this assumption has proven far from accurate (for more complete discussion, see Mayer & Akamatsu, 1999; Musselman, 2000; Singleton et al., 1998; Wilbur, 2000). In addition, research on the acquisition of cued speech has shown that consistent exposure to a communication system at home and at school is an essential ingredient to the development of enhanced literacy skills (e.g., Leybaert, 1998). Comparable data with regard to English-based signing and ASL are not yet available.

The greatest challenges confronting young readers who are deaf appear to lie at the level of individual words, including phonology and word meanings, rather than English grammar as was

traditionally assumed (e.g., King & Quigley, 1985). One of the most central and interesting issues in this regard concerns how children can make use of phonological information in the absence of hearing because phonological processing normally depends on auditory input.

***Phonological Processing***

Several studies have indicated that the ability of children who are deaf to decode spelling patterns first emerges around the second grade. By about age 10, several years later than hearing peers, those children are seen to make use of phonological information during reading, especially when words follow regular spelling patterns (see Marschark & Harris, 1996). Despite having this ability, children who are deaf often depend more on how a word looks on the lips, fingers, or the printed page than how it sounds (Harris & Beech, 1998; Padden, 1991).[12] The ability to use phonological information during reading also does not appear to be directly tied to the amount of hearing loss or to whether children use spoken language or sign language, although children in simultaneous communication programs and spoken language programs do tend to show more frequent use of such information relative to children in ASL-oriented programs (Miller, 1997; Musselman, 2000; Wilbur, 2000). Phonological skills also are enhanced in children with better speech relative to those with poorer speech, but we know that they are separate from speech skills and cannot be explained on the basis of articulation alone. Rather, the bases for phonological abilities in readers who are deaf involve a combination of information drawn from articulation, speechreading, fingerspelling, residual hearing, and exposure to writing, no one of which is sufficient in itself (see Leybaert, 1998; Padden & Ramsey, 1998).

Phonological skills may contribute to better grammatical skill and better reading comprehension, because consistent internal speech has been shown to be more efficient than either visual imagery or internal sign language for the ongoing memory demands of reading (e.g., Lichtenstein, 1998). For competent readers, information about words is held and accumulated until relations among words (grammatical information) and relations among events (discourse information) reveal the meaning of a phrase or sentence. The superficial grammatical structure of the unit is then forgotten, and only the meaning retained. Young deaf readers tend to focus more on individual words rather than relations among words, however, compared to both age-matched and reading-matched hearing children. This orientation disrupts both grammatical processing and top-down semantic processing, thereby reducing comprehension and retention (Marschark, DeBeni, Polazzo, & Cornoldi, 1993).

***Semantic Processing***

A variety of studies have demonstrated that deaf children of hearing parents have fewer signed and spoken labels for things around them than hearing children of hearing parents or deaf children of deaf parents. They also are less likely to gain such knowledge from reading. Special efforts, therefore, must be made to expand the vocabularies of deaf children through print, sign, and speech. The more vocabulary they encounter, the bigger their vocabularies will be; and the bigger their vocabularies, the better they will be able to deal with new vocabulary (see Lederberg & Spencer, 2001, for review).

Compared to normally hearing children, children who are deaf are more likely to use concrete nouns and familiar action verbs over more abstract or general words with which they may have less experience. These differences appear to follow directly from their reduced access to spoken language and the relative lack of skilled sign language models available to them. In general, their vocabularies also tend to lag about a year behind their other reading subskills. This mismatch may disrupt fluent reading, as access to individual word meanings requires greater cognitive capacity in the absence of full comprehension of the preceding context. This suggestion is supported by findings indicating that grammatical structures that put the greatest load on working memory (e.g., pronouns and embedded clauses) appear to be those most difficult for deaf children to master (Marschark & Harris, 1996). The result would be reduced comprehension and reading speed, as well as a tendency to remember disconnected portions of texts rather than the whole picture, especially when the material is unfamiliar (Marschark et al., 1993).

The vocabularies of children who are deaf and children who are hearing might be expected to converge with increasing age and experience with language. While there do not appear to be any studies that have directly addressed this issue, performance on tests such as the Stanford Achievement Test and the American College Test indicate that lags increase throughout the school years. Even among college students, concepts appear to be less well-defined within the mental lexicons of students who are deaf, and not as strongly interconnected on the basis of meaning as they are for hearing students (McEvoy et al., 1999). Vocabulary skills thus appear to be greater when words have only a single meaning and when they are presented in context rather than in isolation.

In summary, recent research has shown that deaf children have access to phonological information, at least by the middle-school years, even if they do not use it regularly when they read (Harris & Beech, 1998; Marschark & Harris, 1996; Padden, 1991). Deaf children generally have smaller receptive and expressive vocabularies than hearing peers, although early access to language (spoken or signed) reduces that difference. The available evidence also suggests that the reported differences between reading abilities of deaf children with deaf parents and those with hearing parents are at best inconsistent. This conclusion raises some questions about the impact on literacy of bilingual approaches to educating children with hearing loss; therefore, it is worth giving some specific consideration to the issue.

***Bilingual Education and Literacy***

With the relative lack of success in improving literacy demonstrated by programs that have utilized simultaneous spoken and signed language, the trend toward balanced ASL-English bilingual education for deaf children has been growing. Although ASL typically is promoted as the first language for children in these bilingual programs (Singleton et al., 1998), their goal is ultimately to provide access to both proficient ASL and proficient spoken/written English. There is considerable diversity in these bilingual approaches to language learning and their impact has not been fully evaluated (Strong, 1995). However, there is some consensus that these programs hold promise and a recent survey of teachers and researchers indicated that evaluating these programs is at the top of their research agenda (Marschark, 2001).

It is tempting to assume that early exposure to language through sign language would provide a linguistically-based advantage in reading development of deaf children with deaf parents, and indeed, some investigators have found that deaf children of deaf parents tend to be better readers than deaf children of hearing parents (Ramsey & Padden, 1998). However, the specific advantage of early access to ASL may be balanced by the fact that its vocabulary and syntax do not parallel those of printed English (Mayer & Akamatsu, 1999; Mayer & Wells, 1996). Strong and Prinz (1997), for example, examined the relations of ASL skill and English literacy scores among residential school children, aged 8 to15 years. They found that fluencies in the two languages were related in children with hearing mothers, but not in children with deaf mothers. The current state-of-the-art in research, then, suggests that early exposure to sign language could be particularly beneficial for the reading abilities of deaf children, giving them the advantage both of early exposure to language and English-relevant linguistic experience (e.g., Tomblin et al., 1999).

Singleton et al. (1998) and Mayer and Akamatsu (1999) have made convincing theoretical arguments supporting the notion that both ASL and English-based signing are essential to academic success for deaf children (in English-speaking countries). The question is how to achieve the goal of fluency in both languages. ASL provides access to early communication with parents and others, an essential component of the language and cognitive skills underlying literacy and academic success in other areas (e.g., Calderon & Greenberg, 1997). Consistent with this view, Erting (1992) pointed out that the mapping from spoken or signed language to written language is something that is not evident on its surface and needs to be taught. Mayer and Wells (1996) and Mayer and Akamatsu (1999) argued that ASL, not having a written form, cannot provide a bridge to written English on its own. Mayer and Akamatsu, therefore, suggested that some form of English "on the hands," if done fully, accurately, and consistently, should optimize development of literacy skills among deaf children (cf. Johnson et al., 1989). Singleton et al. (1998), in contrast, have argued that printed English gloss may be sufficient for the acquisition of English fluency. The challenge, of course, is ensuring that whatever language or mode employed, it is used consistently at home and school, and in association with good instructional practice.

Most available research, in contrast, has demonstrated that in the hands of non-fluent signers, simultaneous communication usually does not provide deaf children with access to the sign language component (e.g., Johnson et al., 1989; Supalla, 1991). Leigh (1995) has shown that competently signing teachers can provide fluent simultaneous communication in both signed and spoken language, at least to children in younger grades. The impact of *fluent* simultaneous communication on academic achievement of children who are deaf, however, has not yet been the subject of rigorous research. In addition, we need to examine the relationship of motivation, exposure to reading, and quality of teaching to literacy. The effects of early exposure to reading, via parents and early school environments, seems a particularly important area of study, given findings that children who read more become better readers, and better readers read more.

Taking a narrower rather than a broader approach to reading, it also is important to consider the various subskills involved in reading as they relate to language development. Deaf and hearing children, as well as deaf children of deaf parents and deaf children of hearing parents, may differ in these component skills even when their overall reading levels are the same. Alternatively, they may

be similar on particular dimensions that create overall differences in reading level. In any case, without broad evaluations of bilingual education programs and their influences on literacy and academic achievement, it is too soon to evaluate their potential impact in any particular area. Clearly, the various language-oriented educational methods tried over the past 100 years have had only limited success in fostering greater educational success (Allen, 1986).

Several alternatives to current ASL-English bilingual programs also have been suggested. Beyond the possible use of English gloss, ASL might be combined with either simultaneous communication or cued speech to provide a more effective bridge from early language (via ASL) and literacy (via English). Several programs in England recently have adopted such an approach to education, combining British Sign Language and *sign-supported English* (essentially manually coded English), but it is too early to determine the extent of their success. Wilbur (2000) has made a similar suggestion, based largely on research with deaf children of deaf parents, advocating the initial use of ASL to provide early access to language; followed by a combination of ASL and written English to promote literacy; then followed by a combination of ASL, written English, and spoken language if desired. Either of these possibilities would fit with the theoretical arguments proposed by Mayer and Wells (1996) and Mayer and Akamatsu (1999), but only time and evaluation will determine whether or not they work.

## Summary

### *What Do We Know and Where Are We Going?*

Language is an essential component of normal development and a means for interpreting and expressing the world. However, because the vast majority of children who are deaf are born to non-signing hearing parents, many of them do not have full access to language during the most critical ages for language acquisition, the first three or four years. All available research indicates that for most children who are deaf, exposure only to spoken language often falls short of providing the linguistic tools necessary for academic and social purposes. While access to English may be essential for literacy, it is most important that children who are deaf, like children who are hearing, be able to communicate with their parents from the beginning. The importance of early and effective communication between deaf children and hearing parents and of the availability of incidental learning from family members, TV, etc. also supports the use of technology to improve auditory perception (e.g., cochlear implants, hearing aids), even though the long-term impact of such technologies remains unclear.

From vocal and manual babbling, to first words and signs, to more complex language, normal language development depends on frequent and regular communication between children who are deaf and those around them, regardless of whether it is through signed or spoken language. Gestures serve practical communicative functions for children regardless of whether they are deaf or hearing, and the gestures they use are markedly similar. As they develop, their vocabularies grow and their gestures are complemented by conventional language. While gestures may have a special role within American Sign Language (ASL), they are natural and normal for all children.

There is no evidence that preventing the use of gestures by children who are deaf has any positive impact on their spoken language skills, and there also is no evidence that early sign language learning impedes or prevents spoken language learning. Sign language may even provide a bridge to spoken English, although different children will excel in and prefer different modes of communication. Increasing complexity and skill in signed and spoken language subsequently follow the same course in deaf and hearing children, even if a lack of early language experience creates a lag in development for some children who are deaf. It is also important to note here that there is no evidence that early cochlear implantation impedes or prevents the acquisition of signed language or has a negative effect on the child's psychological or social development.

Children who are deaf but who have early access to language through parents who are deaf, demonstrate patterns of language development that follow the same sequence and rate that is observed in hearing children with hearing parents. For young deaf children of hearing parents, a variety of factors will influence language development, including parents' acceptance of their children's hearing losses, visual access to communication, use of external hearing aid technologies, and cochlear implantation. Parents who are deaf have a variety of strategies that they use to ensure that their communication is effective, including touch and signing within the child's line of site. Most importantly, perhaps, their communicative interactions with their young children are less disruptive and more natural than the communicative interactions of hearing parents with their deaf children. Hearing mothers of young children who are deaf, meanwhile, may be more controlling and intrusive in their language interactions, characteristics that appear to impede both language development and social development.

The best predictors of language development and academic success, at least in the early school years, include effective mother-child communication, enrollment in early intervention programs, and early use of sign language. This is not to say that sign language will be the appropriate mode of communication for all deaf children. However, on average, deaf children who are exposed to sign language during infancy and preschool years have more effective communication experiences and surpass their deaf peers in language, social, and cognitive development. They also show greater language fluencies in ASL and English as adults. Early indications suggest that many children with cochlear implants benefit significantly from exposure to sign language and spoken language because multiple sources of language information tend to support language acquisition rather than conflict with each other.

Several studies have now reported impressive language gains among children with cochlear implants, relative to pre-implantation baselines. In contrast to the relatively steep learning curve for adults who receive cochlear implants, children's language skills continue to improve over time. Children who have demonstrated the most success with implants are those who have had some amount of early auditory experience prior to losing their hearing and extensive rehabilitation post implantation. Well-designed longitudinal research on young children with cochlear implants is just beginning to appear in the literature and is an important contribution to the knowledge base.

For many people, the most frustrating finding concerning language development of children who are deaf is the fact that we have not yet found *the* approach that supports development across the

domains of social functioning, educational achievement, and literacy. A single such approach is unlikely, given the heterogeneity of these children. Educators and researchers alike thus continue to seek a balance between the provision of effective early communication skills and the provision of English skills needed for academic success. Currently, bilingual education programs appear to offer that possibility, although most such programs are not truly balanced because access to English remains more problematic than access to sign language. Also, it may be that ASL and other natural sign languages do not provide an effective link to reading and writing skills. Suggestions for combining ASL with some form of English-based signing have been made but not fully tested, and previous incarnations of mixed communication strategies typically have not provided children who are deaf with full access to ongoing communication. Evaluation of these alternatives requires careful and consistent monitoring to ensure that they are being used in quality instructional environments. It may well be that the apparent failure of some educational methods is primarily the result of poor implementation.

Evaluation of the bilingual education programs already in place is a high research priority from the perspective of teachers as well as researchers interested in language development, social development, and education. Also high on the research agenda is the impact of new technologies on language development and educational achievement. This includes the need to study long-term effects of cochlear implants on language development, speech perception, and production; and the potential roles for closed captioning, TTYs, and use of the other technologies on literacy skills. The impact of oral and sign language interpreting in the classroom also remain to be investigated, both in terms of effectiveness and impact on specific domains of language growth. In short, language plays a key role in development and the challenge is optimizing language development in order to foster success in other areas.

***How Available Research Should Guide Practice***

To some readers, this review may be disheartening, suggesting that there are more questions than answers with regard to language development in children who are deaf. From the perspective of most researchers and teachers, however, this is not the case. More progress has been made in this domain during the last 15 years than in the previous 150. We now know more about what works and what does not work to promote language development, both practically and theoretically, and there are clear implications for parenting and educational practice, even if those links have not been adequately publicized or embraced. Indeed, there are a variety of educational practices that have changed as a function of research in this area, including the use of more visually-oriented teaching strategies, the early use of sign language to enhance language and cognitive development, classroom activities that emphasize relations among concepts, and more spoken language in early education settings. More spoken language is especially important for children with residual hearing. The most obvious and pragmatic implications for practice that emerge from the present review are described in the following paragraphs.

The first important recommendation is better education for hearing parents. Regardless of the mode of communication they choose for their child, parents need to understand the challenges of communication and be provided with appropriate strategies. Parent training programs have been

implemented in other countries, and several investigators and practitioners are seeking to do the same in the United States. Early results suggest that parents find these programs to be positive experiences and helpful for communication with their children, even if longer-term implications for development have not yet been determined. Parents also should be advised about the importance of reading with their young children, and instructed on methods by which they can combine sign language with either a spoken language or sign-supported spoken language. Early reading experience not only may directly facilitate language development and literacy in children who are deaf, but it also demonstrates the value placed on such skills by parents, thus increasing motivation and self-directed learning.

Within the classroom, reading and writing activities should be given high priority. Programs in which stories have been presented in both sign language and spoken language, where young children all have copies of the same story book, and where parents have materials that allow them to share with their children stories first presented at school, appear to have a positive impact on language growth. Having children re-tell stories at home, collect or draw relevant pictures, and act out portions of the stories all help to establish links between the written word and meaning. The importance of reading should be modeled by both deaf and hearing adults, and reading and writing activities used by both with young children who are deaf.

In order to foster both language development and literacy skills, greater attention should be given to categories, relations among concepts, and multiple meanings of words. All three of these represent areas in which children who are deaf appear to lag behind their hearing peers both in terms of language use and literacy. Particularly during the early years of language development, visual aids should be used in establishing links between words and their superordinate and subordinate categories, as well as coordinating relations among concepts. Analogies, ambiguities, and nonliteral language also deserve greater attention, and can be integrated with activities in the preceding areas.

Finally, parents and teachers should take advantage of opportunities for interaction among children and diverse language models. Interactions with language models whose communication is accessible (either with peers or adults) will provide broad-based support for language growth. In general, adults make better language models than children, but peer influences increase through the school years, and it is essential to exposure children to competent, accessible communicators who are valued. But exposure to language usually is not enough, especially if children are raised in environments in which they do not have full access (including good models) to a natural language. Most children who are deaf need some kind of language instruction in addition to the informal instructional activities and games that many deaf and hearing parents engage in at home with their deaf or hearing children (e.g., Marschark & Everhart, 1999; Singleton et al., 1998).

### *How Available Research Should Guide Policy*

The research reviewed in this document indicates that administrators and policymakers can have more immediate and direct impact on the language development of children who are deaf by supporting early intervention programs for their families and establishing parent-training workshops in specific areas like those described above (e.g., early visual communication strategies, foundations

of literacy). The research-supported value of early sign language for children who are deaf points to the need for quality sign language classes for parents, siblings, and other significant caregivers with special attention to underserved populations such as those in rural or geographically isolated areas. Finally, greater numbers of deaf language models are needed in the classroom, and such models should demonstrate bilingual fluencies. Hearing individuals in the classroom also need to demonstrate bilingual fluencies, and higher expectations for sign language skill can only enhance access to information in the classroom and language abilities of children with hearing loss.

With regard to research policy, several areas in which there is support (and pressure) for research have already been described. Teachers and researchers agree on the urgent need to implement evaluation procedures for early intervention and bilingual education programs already in place (Marschark, 2001). Faced with implicit and explicit demands for newer and more sophisticated instructional technology at increasing costs, educational administrators join teachers and researchers in advocating for more research demonstrating the impact of new technologies on language development and academic progress. Overall, greater research consideration must be given to which technologies offer long and short-term benefits in which domains. Only specifically directed research and comparisons with baseline performance can provide such information.

A variety of recommendations for research and practice were provided by the Commission on Education of the Deaf (1988), many of which are still in need of implementation. Evidence reviewed by the Commission and more recent evidence reviewed in this document indicate that research should be directed toward determining methods for improving access to and the richness of language available to young children who are deaf in order to facilitate language development. Most important, even if they are expensive, are longitudinal studies examining the impact of exposure to different early interventions and alternative early language environments.

The research reviewed above offers one other important recommendation, one concerning who should be involved in decision-making that affects children with hearing loss. Parents have the right to make decisions about educational programming for their children in cooperation with educational professionals. Unfortunately, these decisions may be made with only limited access to pertinent research-based information. Parents and children are sometimes channeled into programming determined more by convenience and administrative expediency than by individual and family needs. A broad range of alternative services is necessary to be able to provide optimal support for the heterogeneous needs of children who are deaf. Understanding that school systems and other agencies are limited in their resources, care must be taken to ensure that those resources are well spent. Policymakers, therefore, need to establish some means of ensuring that parental involvement, utilization of resources, and children's needs are balanced without having the process collapse under its own weight. More education for parents, teachers, and other adults who spend a significant amounts of time with children who are deaf, including up-to-date information on research findings, clearly would be beneficial for all concerned.

## Glossary

*American Sign Language (ASL)* - The natural sign language used in the United States and English-speaking parts of Canada that has its own grammar. It is distinct from spoken and written English.

*auditory* - Relating to how sound is heard (versus *acoustic*, relating to the physical properties of sound).

*bilingual-bicultural programs* - Often called "Bi-Bi" programs, these academic programs emphasize both ASL and English (reading and writing) while encouraging children to learn about both deaf and hearing cultures; however, there is no single model or definition.

*cognitive development* - The development of children's skills in thinking, memory, problem solving, etc.

*congenital* - From birth. "Congenital or early onset" hearing losses occur prior to language learning and typically result from hereditary factors or from maternal or infant illness.

*cued speech* - Supplementing of spoken language through several handshapes placed in different locations around the face, used to distinguish sounds that look similar on the lips.

*fingerspelling* - Use of the manual alphabet within a sign language to spell words.

*gloss* - The translation of ASL signs into written English.

*grammar* - The set of internalized rules that allow the fluent user of a language to produce essentially an infinite number of correct ("grammatical") utterances. Also called syntax.

*IDEA* - Individuals with Disabilities Education Act. Originally enacted in 1975 as the Education for All Handicapped Children Act and subsequently amended by other laws.

*inclusion* - Educational philosophy advocating the education of all children with disabilities in general education classrooms.

*Individualized Education Program (IEP)* - a written educational plan for each child with a disability that is developed, reviewed, and revised in accordance with the IDEA.

*inflection* - Often referring to "tone of voice," but here relating to the modification of words or signs to indicate number, tense, manner, or other grammatical information.

*mainstreaming* - Educating children with disabilities in the general classroom for part or all of the school day, with the support of interpreters and/or other services.

*manually coded English* - Use of ASL signs, special vocabulary, and English grammar to communicate English through the hands (e.g., Signed English, cued speech, SEE1, and SEE2).

*residential school* - Schools where children may live on campus.

*residual hearing* - Hearing that remains following significant hearing loss. Hearing aids and other amplification devices depend on residual hearing for effectiveness.

*simultaneous communication (SC)* - Simultaneous production of both sign and speech (see also *total communication*).

*speechreading* - Understanding spoken language through visual analyses of mouth and face movement. Usually effective only with significant residual hearing. It is extremely difficult and tiring, especially for those spoken languages (like English) that have many similar mouth-shapes. Also know as "lipreading."

*total communication (TC)* - Communication method which makes use of all potentially available sources of linguistic communication, including sign, speech, and amplification.

*TTY (or TDD)* - "Visual or text telephone" for people who are deaf, using keyboard and written visual display.

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**Related Readings and Resources**


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Websites:

National Institute on Deafness and Other Communication Disorders, NIH
http://www.nidcd.nih.gov

Alexander Graham Bell Association for the Deaf and Hard of Hearing
http://www.agbell.org

National Association of the Deaf
http://www.nad.org

Council on the Education of the Deaf
http://deafed.educ.kent.edu/

## Endnotes

1. Note that the "primary" mode of expressive language and the "primary" mode of receptive language may be different. For example, most children who use cued speech (from others) for receptive purposes do not cue themselves. And, many profoundly deaf children who gain little information from (receptive) speech nonetheless use (expressive) spoken language themselves.

2. Mayne, Yoshinaga-Itano, Sedey, and Carey (2000) and Mayne, Yoshinaga-Itano, and Sedey (2000) reported similar, impressive gains in language development for children whose hearing losses had been identified early. They failed to find any significant differences in expressive or receptive language, respectively, among children on the basis of communication mode. "Communication mode," however, was based solely on observations, prior to the study, of "whether the caregiver or child was observed using any signs during a 25-minute video sample of a play interaction," and results are not presented in a way that allows comparisons of children who used primarily signed language or spoken language. It is thus unclear whether very early intervention potentially eliminates the usual early vocabulary advantage for children acquiring sign language relative to those acquiring spoken language or the Mayne et al. methodologies simply were not appropriate for detecting such differences.

3. Unless otherwise noted, "English" is used here generically to refer to any spoken/written language. "Sign language" also is used generically to refer to any natural sign language (e.g., American Sign Language, British Sign Language) and closely related variants such as English-based signing.

4. Controls within the study ensured that these findings did not result from fathers' presence in the home influencing the ways in which mothers interacted with their deaf children, thus giving the appearance of a direct influence on children. The father-presence effect appears to be a relatively direct one.

5. Bronowski and Bellugi (1970) and others have argued that "carving up" the world in terms of the functional meaning is a basic (innate) information processing ability in infants. While there are arguments suggesting that language-related abilities have a separate, perhaps preeminent status, the issue has not been resolved and is beyond the scope of the present discussion.

6. The study by Todd (1976) is the most frequently cited in this regard. His report concerns a deaf child of deaf parents raised with ASL as his only language until he was three years old. Todd reported that ASL structure frequently intruded into the child's later English productions, a phenomenon not uncommon in children learning a second language. Most references to Todd (1976), however, imply that he found that sign language acts as an impediment to spoken language (e.g., Evans, 1988; Sharpe, 1985).

7. There do not appear to be any published statistics concerning the use of spoken language among children who are deaf versus those who are hard of hearing. Sources such as the Gallaudet University Annual Survey of Hearing-Impaired Children and Youth do not partition their data in this way, and reliable estimates are difficult to find.

8. As in most research involving groups of children who are deaf, communication fluencies varied widely and, in particular, children in this study displayed a range of sign language use from Pidgin Signed English to ASL.

9. Note that the same data were reported by McConkey-Robbins, Osberger, Miyamoto, and Kessler (1995), although citations by other investigators in the literature might suggest that these are two independent confirmations of the value of cochlear implants. See Miyamoto, Svirksy, and Robbins, 1997, for a follow-up study.

10. Speech-to-print software produces both upper-case and lower-case letters when punctuation is explicitly stated by the speaker. It does not make spelling errors, but it does insert incorrect words that are the best match with what was produced. Like captioning, speech-to-print output reproduces spoken language, which is frequently ungrammatical.

11. Cued speech is included in the category of manually coded English based on recent research, primarily in Europe, showing that deaf children who are exposed to cued speech from an early age show impressive performance in a variety of reading subskills (see Leybaert, 1998, LaSasso & Metzger, 1999, for reviews). Importantly, those results hold up only when children use cued speech consistently both at home and at school.

12. Similar findings are seen in the understanding of fingerspelling within sign language. Although letter-by-letter analysis often occurs for new or unfamiliar words, fingerspelling is generally understood in terms of overall patterns rather than in terms of their component letters for both deaf and hearing signers.